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# Dash II model MT Operations Manual

Astro-Med, Inc.

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# DASH II model MT
# Operations Manual

Astro-Med
Part Number
22834220

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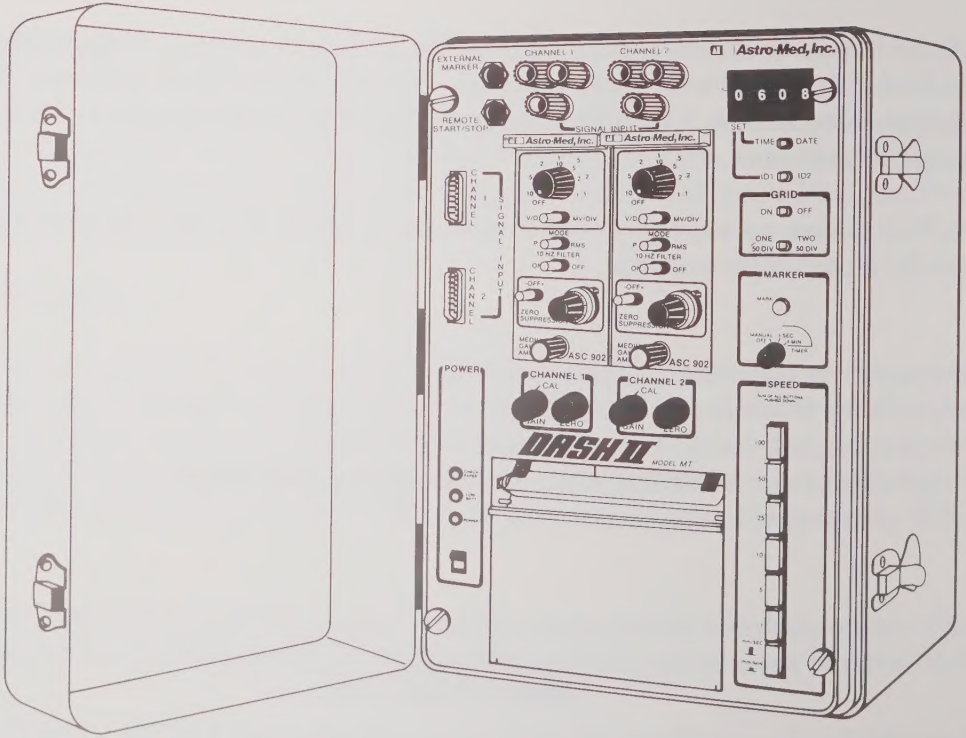


Astro-Med's DASH II model MT Recorder

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# Section 2
# Hardware Setup

## 2-1 Setup Upon Receipt

Your DASH II requires very little setup. In most cases, the recorder is shipped with the signal conditioners of your choice already installed. All you have to do is perform the simple wiring needed to make the phone plugs supplied with your recorder functional. The phone plugs are used with the recorder's EXTERNAL MARKER jack and REMOTE START/STOP jack. You may also need to wire the two 15-contact D-shell pin housings that come with your recorder. These pin housings mate with the DASH II's front-panel D-shell connectors and are used to input signals into the recorder. In each case, the necessary wiring is straighforward and is fully explained and illustrated. If requested, Astro-Med will configure the recorder's fuse block and voltage selection card to meet European voltage requirements. Alternatively, you can reconfigure the recorder's fuse block and reorient its voltage selection card yourself. This is fully explained below. First, let's look at a complete list of what is supplied with the DASH II.

## 2-2 Standard Items Shipped With DASH II

Your DASH II recorder is shipped with the connectors, supplies, and documentation listed below. As you unpack your recorder, check to see that all the items listed have been included. If any of the items listed below are not present, call our customer service department at (401) 828-4000.

*In most cases, two signal conditioners with their respective manuals are supplied with the recorder. Their cost is in addition to the above supplied items.*

- One DASH II model MT recorder with Operations Manual
- Two packages of black imaging thermal Z-fold paper; 60 to 150 feet per pack, 500 sheets
- One power cord (16 AWG 1650 WATTS)
- Two 15-contact D-shell cable clamp assemblies

- Two 1/4" three-conductor phone plugs
  (for use with the EXTERNAL MARKER jack and the REMOTE START/STOP jack)*

- One 3-contact auxiliary power plug for use with the EXTERNAL INPUT 11-18 VDC connection*

- Two red dust covers for the front-panel 15-contact D-shell connector inputs

- One vinyl pouch with velcro straps for attachment to the exterior of the DASH II case

**Please note that you will have to supply the cabling required for use with your recorder's phone plugs and 3-contact auxiliary power plug.*

- Two subminiature 15-contact D-shell pin housings with solder cups**

  ***Pin housings are wired in accordance with the types of signal conditioners with which they are used. You will need to consult the Operations Manuals supplied with your signal conditioners to wire these pin housings.*

## 2-3 Removal and Installation of Signal Conditioners

Two ASC-900 Series signal conditioners of any mix can be installed in the built-in card cage of the DASH II. In most cases, the DASH II is shipped with the signal conditioners that you ordered already installed and ready for use. If, for any reason, you wish to remove, reinstall, or replace them, follow the instructions provided in the paragraphs below.

### 2-3.1 Removal / Installation Procedures

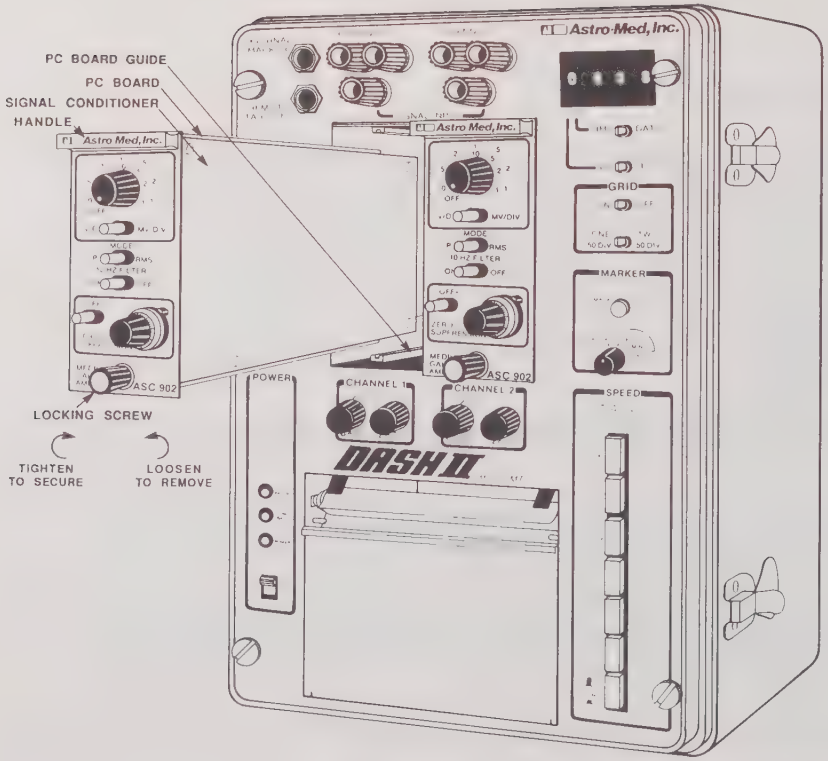
Figure 2-1 illustrates the process of removing signal conditioners from or installing them in the recorder's built-in card cage. Refer to this figure when removing signal conditioners from or installing signal conditioners in your DASH II. Please observe the following precautions when performing removal or installation procedures.

**WARNING / CAUTION**

Turn recorder power OFF before removing or installing signal conditioners.

When removing the signal conditioner from the card cage, never pull on the signal conditioner controls. The controls may break.

Do not force the signal conditioner into place. If the signal conditioner doesn't easily slide into place, remove it from the card cage and realign it within the PC board guides.




## For Signal Conditioner Removal

1. Turn the locking screw located on the bottom of the signal conditioner counterclockwise until it is fully loosened.
2. Grasp the locking screw at the bottom and the handle at the top of the signal conditioner and firmly slide the signal conditioner out of the card cage.

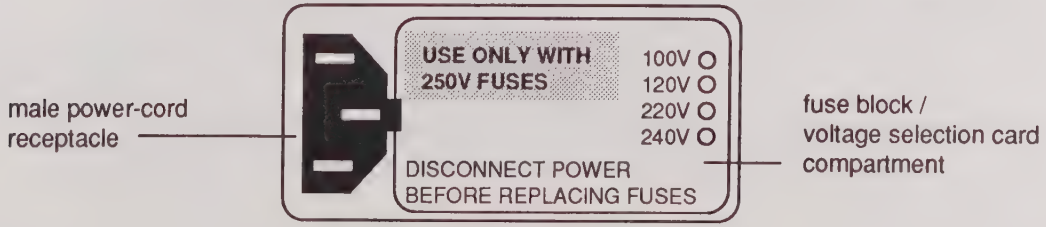
## For Signal Conditioner Installation

1. Align the signal conditioner PC board with the board guides in the card cage.
2. Carefully slide the signal conditioner into the card cage until it clicks into place.
3. Turn the locking screw completely clockwise to secure the signal conditioner in place.

Figure 2-1. Signal Conditioner Removal/Installation

## 2-4 Line Voltage Requirements

Typically, the fuse arrangement and voltage card orientation of the DASH II are set to accomodate the standard North American AC line voltage of 120 VAC. However, the recorder's operating AC line voltage can be set to either 120 VAC or 240 VAC by adjusting the placement of fuses within the fuse block and by changing the orientation of the voltage selection card. The power entry module (shown in isolation below) contains the power cord receptacle and the fuse block / voltage selection card compartment. The appropriate voltage has been factory-set to your requirements and should not need immediate adjustment. The frequency range is 48-440 Hz. Paragraphs 2-4.1 and 2-4.2 discuss configuring the fuse block and changing the voltage selection card orientation to meet your specific voltage requirements.

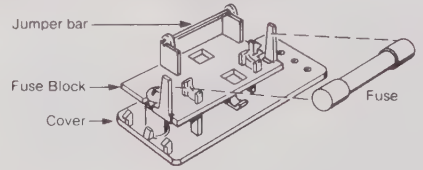


### 2-4.1 Changing the Fuse Block Arrangement

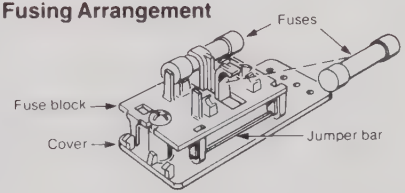
If you want to change the factory-set fuse block arrangement, use the procedure given below. The figures below show both the North American and European fuse setups.

- The North American fusing arrangement (120 VAC) requires one 1/4" x 1-1/4", 2 Amp, 250 V fuse.
- The European fusing arrangement (240 VAC) requires two 5 mm x 20 mm, 1 Amp, 250 V fuses.

**North American Fusing Arrangement**




**European Fusing Arrangement**



**WARNING**

Power to the recorder must be OFF when changing the fuse block arrangement.

1. **Using a small-blade screwdriver, remove the contents of the fuse block / voltage selection card compartment.**

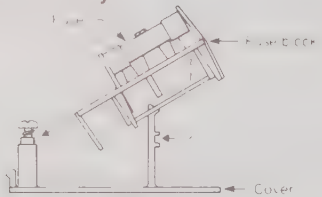
2. **Loosen the screw that attaches the fuse block to the cover of the fuse block / voltage selection card compartment.**

3. **Slide the fuse block upward and pull it away to release it from the screw and pedestal.**

4. **Change the fuse arrangement to the configuration of your choice as shown in paragraph 2-4.1 above.**

5. **Slide the fuse block back onto the screw shaft and pedestal. Tighten the screw.**

Fuse Block/Cover Assembly



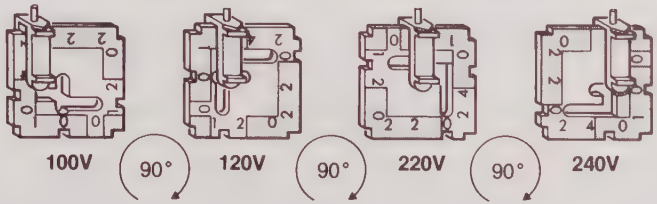

6. **Before reinserting the rearranged fuse block, orient the voltage selector card as described in paragraph 2-4.2 so that the desired voltage is readable at the card's bottom.**

## 2-4.2 Changing the Orientation of the Voltage Selector Card

If you have changed the factory-set fuse block arrangement, use the procedure given below to reorient the voltage selector card. This will establish compatibility between the voltage selector card and the selected fuse block arrangement (either 120 V or 240 V).

1. **Carefully remove the voltage selector card from the fuse block / voltage selection card compartment.**

2. **Adjust the card so the desired voltage is readable at the bottom and the plastic pointer is pointing as shown. When the pointer is set, successive voltages are selected by rotating the card 180° clockwise.**




3. **Return the voltage selector card to the compartment with the printed side of the card facing the male connector and the edge containing the desired voltage facing the compartment cover.**

4. **Reinstall the contents of the fuse block / voltage selection card compartment.**

## 2-5 Recorder Power Connections

Power can be applied to the DASH II in three ways:

**16 AWG 1650 Watt Power Cord** The power cord allows you to plug the recorder directly into an AC power source.

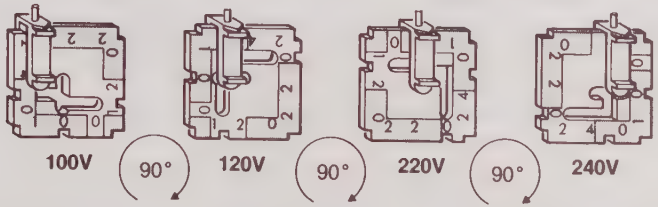
**3-Contact Auxiliary Power Plug** The auxiliary power plug is provided for use with the EXTERNAL 11-18 VDC INPUT connector. This connector is located on the side of the DASH II. (See figure 3-2.)

*You must provide your own cable (18 AWG or larger) to wire the 3-contact auxiliary power plug for use with the 11-18 VDC INPUT connector.*

**Rechargeable 12V 6.0 A Gel Type Batteries** The batteries of the DASH II provide power for approximately 2-3 hours of operation.

1. **Carefully remove the voltage selector card from the fuse block / voltage selection card compartment.**

2. **Adjust the card so the desired voltage is readable at the bottom and the plastic pointer is pointing as shown. When the pointer is set, successive voltages are selected by rotating the card 180° clockwise.**




3. **Return the voltage selector card to the compartment with the printed side of the card facing the male connector and the edge containing the desired voltage facing the compartment cover.**

4. **Reinstall the contents of the fuse block / voltage selection card compartment.**

## 2-5 Recorder Power Connections

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*You must provide your own cable (18 AWG or larger) to wire the 3-contact auxiliary power plug for use with the 11-18 VDC INPUT connector.*

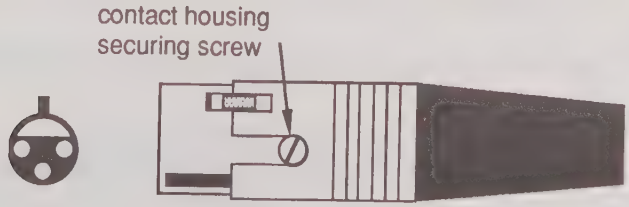
**Rechargeable 12V 6.0 A Gel Type Batteries** The batteries of the DASH II provide power for approximately 2-3 hours of operation.

### 2-5.1 Wiring the 3-Contact Auxiliary Power Plug

Follow the instructions below to wire the 3-contact auxiliary power plug for use with the EXTERNAL 11-18 VDC INPUT connector. The accompanying figures illustrate the wiring process.

1. **Loosen the screw that secures the contact housing of the auxiliary power plug from the strain relief housing.**

   *Be careful. The screw is very small and can be easily lost if it is completely removed.*

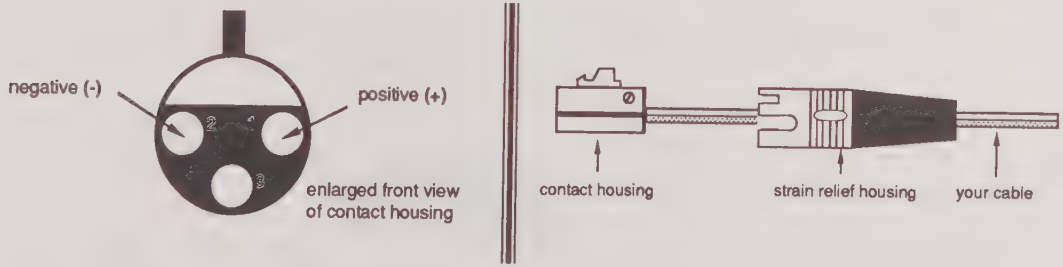


2. **Separate the contact housing from the strain relief housing.**

*There is a plastic tubular insert in the strain relief housing that may come out when you separate the pieces. Be careful not to lose this piece. If this insert should come out, put it back into position in the strain relief housing.*

3. **Run your cable through the strain relief housing.**

4. **Solder your cable wires to the solder cups on the contact housing.**




5. **Slide the contact housing into the strain relief housing.**

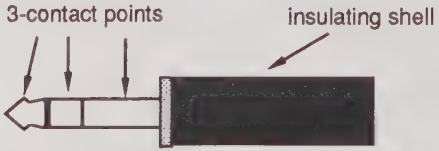
6. **Tighten the contact housing securing screw.**

### 2-5.2 Wiring the 3-Conductor Phone Plugs

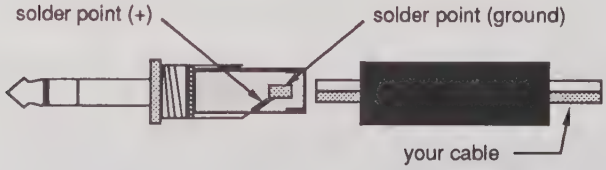
The 3-conductor phone plugs are used in conjunction with the recorder's EXTERNAL MARKER jack and REMOTE START/STOP jack. The phone plugs are identical and are identically wired.

Use the figures and steps below to help you wire these two phone plugs.

1. **Unscrew the metal plug from its plastic insulating shell.**




2. **Run your cable through the plastic insulating shell and solder it to the areas identified below.** ***Note that the tip is not connected.***

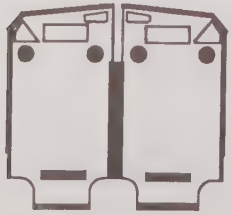



3. **Screw the plastic insulating shell back onto the metal plug.**

The phone plugs are now ready for use with either the REMOTE START/STOP jack or the EXTERNAL MARKER jack.

### 2-5.3 Cable Clamp Assembly/15-Contact Pin Housing

Two 15-contact pin housings are supplied with the DASH II. They are used to input signals through the recorder's two front-panel D-shell connectors labeled CHANNEL 1 and CHANNEL 2. You will need to insert the pin housings into the cable clamp assemblies before they can be used. Refer to the figures below to accomplish assembly of the cable clamp and the 15-contact pin housing. Begin by separating and identifying the cable clamp assembly, 15-contact pin housings, screws, and strain relief insert. You will have two of each item shown.



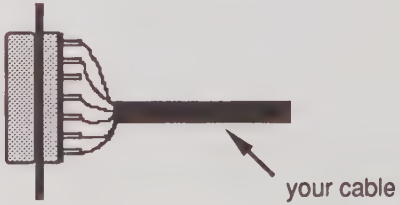
cable clamp assembly (open)

15-contact pin housing

screws and strain relief insert

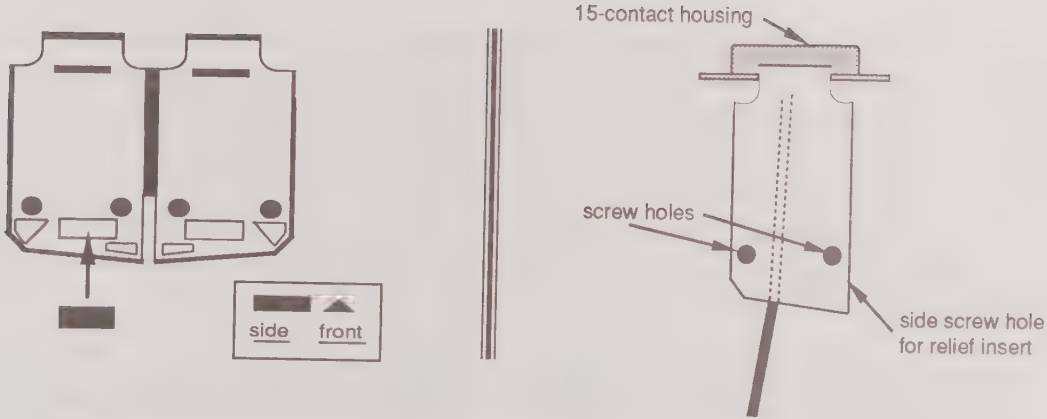
1. **Using the cable that you supply, wire the 15-contact pin housing in accordance with the requirements of the signal conditioners that you are using.**

   *Refer to the Operation Manuals provided with your signal conditioners for wiring instructions.*




2. **Put the the strain relief insert into its recess in the cable clamp assembly.**

3. **Insert the wired 15-contact pin housing into the cable clamp assembly and close clamp assembly to "box" the pin housing and your cable.**




4. **Use two screws to close the strain relief housing.**

5. **Insert the third screw through the hole on the hinged side of the strain relief housing to secure the strain relief insert.**

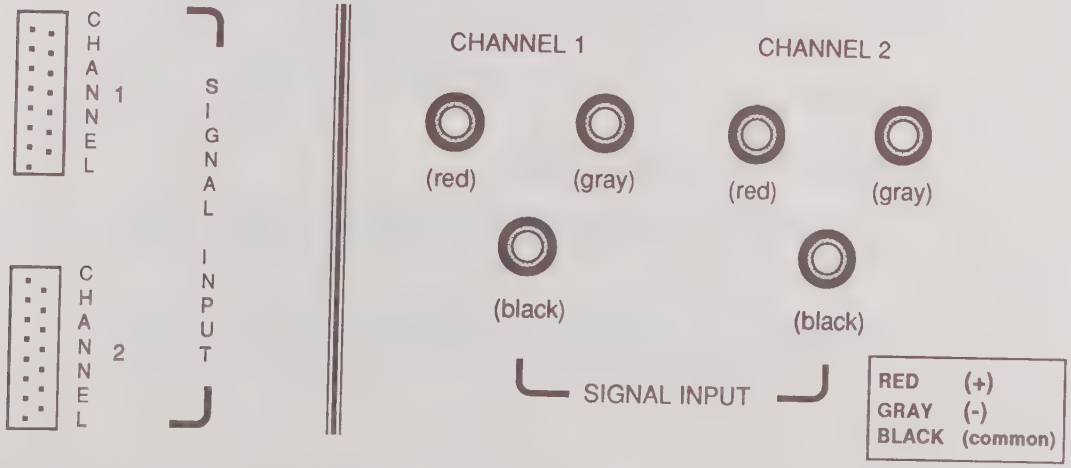
6. **The pin housing / cable clamp assembly is ready for connection to either the CHANNEL 1 or CHANNEL 2 front-panel D-shell. When mated to either front-panel D-shell, the 15-pin housing is secured in place by two screws.**

## 2-6 Front-Panel Signal Input Connections

To accomodate signal input, the DASH II is equipped with two front-panel 15-pin D-shell connectors labeled CHANNEL 1 and CHANNEL 2 and two groups of 5-Way binding posts. Both types of inputs are used to carry signals from an external source to the two signal conditioners installed in the recorder card cage. However, both types of inputs cannot be used at the same time. Depending upon your application, one kind of input connector may be more convenient than the other.

As previously discussed, two 15-contact D-shell pin housings are supplied for use with the recorder's front-panel D-shell connectors. Assembly of the cable clamp housings with the associated pin housings is detailed in 2-5.3 above. The wiring required by the pin housings depends on the signal conditioners being used in the recorder. You will need to refer to the Operation and Service Manuals that accompany your ASC-900 Series signal conditioners for information regarding the wiring of the pin housings.

Like the 15-contact D-shell input connectors, the 5-Way binding post inputs are used to input signals into the signal conditioners. However, the binding post inputs cannot be used with all signal conditioners. Banana plugs are commonly used in conjunction with the 5-Way binding posts. Banana plugs are not supplied with your recorder. Please supply them if they are required for a specific application.



## 2-7 Signal/Power Connections Summary

The following steps summarize recorder signal/power connection instructions.

1. **Attach the signal source to the recorder by using the appropriate 15-pin D-shell connectors or by inserting the banana plugs that you have supplied into the appropriate 5-way binding posts.**

2. **Provide power to the recorder in one of the following ways:**

   **If an AC power source is used:**

   - Attach the female end of the power cord to the receptacle on the side the recorder. Insert the male end of the power cord into an AC outlet.

     Place the power switch in the "on" position.
     ("|" showing on the switch)

**If the EXTERNAL 11-18 VDC input connector is used:**

- Attach the 3-contact auxiliary power plug to the EXTERNAL 11-18 VDC jack on the side of the recorder. Attach the other end of the auxiliary power plug to the DC power source. See paragraph 2-5.1 for instructions on wiring the 3-contact auxiliary power plug.

  Place the power switch in the "on" position.
  ("|" showing on the switch)

**If the batteries are used:**

- Place the power switch in the "on" position.
  ("|" showing on the switch)

  Batteries are factory installed and should be kept charged for proper recorder function.

## 2-8 Accessing the Recorder's Batteries and Internal Fuses

The DASH II contains two factory-installed gel-type 12-volt batteries and three 7A fuses. Follow the procedure given below to access these components.

1. **Ensure that the DASH II is unplugged and disconnected from all power sources. In addition, ensure that the POWER switch is set to "off" (0).**

2. **Place the DASH II on a table or area suitable for the disassembly of the recorder.**

3. **Orient the DASH II so that it rests on its rubber feet (bottom) with the latches of the case facing you.**

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# Section 1
# Introduction

## 1-1 About This Manual

The purpose of this manual is to provide you with all the information required to operate your Astro-Med DASH II model MT™ two-channel, thermal-array recorder. The recorder is referred to as the DASH II throughout this manual.

This manual discusses all of the functions, features, and capabilities of your DASH II recorder. Separate sections of the manual discuss recorder hardware setup, operation, and theory of operation.

Operation of the DASH II requires two Astro-Med ASC-900 Series signal conditioners. A complete family of Astro-Med signal conditioners is available to adapt the recorder to your specific applications. Your recorder is equipped with the signal conditioners specified in your particular order.

Refer to the Operation Manuals that come with your signal conditioners for information regarding signal-conditioner installation and operation. Specifications for each of Astro-Med's ASC-900 Series signal conditioners are presented in appendix C. (Although they are no longer manufactured, ASC-800 Series signal conditioners can also be used with all DASH II Series recorders.)

The system schematic of the DASH II is provided in appendix A.

## 1-2 Recorder Highlights

The DASH II is a portable, two-channel, high-speed, direct-writing recorder. Enclosed in a rugged aluminium case, the DASH II is constructed for reliability and accuracy. The DASH II can be used as both a dependable field recorder and a sophisticated laboratory recorder. The high-resolution thermal array printhead employed by the DASH II eliminates ink and conventional mechanical styli. The elimination of mechanical components and inks results in a highly reliable recorder that produces printed waveforms that precisely represent the original signals. The recorder can create either of two possible grids and simultaneously print waveforms.

The result: total correlation between the recorded waveform and the selected grid. Chart drift error is eliminated. Whether creating two 50-division grids or a single 50-division overlapping grid, the recorder prints accurate amplitudes and sharp waveform traces. The recorder frequency response range is DC to 500 Hz.

The DASH II uses a crystal-referenced stepper motor to advance the paper through the recorder. The stepper motor provides seventy chart-paper speeds ranging from 1 mm/min to 100 mm/sec. The pages that follow list the physical and functional specifications of the DASH II.

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| **Recording Method** | Direct-writing thermal array |
| **Paper** | Low-cost, black imaging thermal paper, Z-fold |
| **Paper Width** | 5 inches (125 mm) |
| **Paper Length** | 148 feet (45m)<br>246 feet (75m) |
| **Number of Channels** | Analog Waveform: 2<br>System Log: 1<br>Event Markers: 2 |
| **Chart Speed** | Seventy chart speeds from 1 mm/min to 100 mm/sec |

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| **Grid** | Self generating, 10 major divisions and 50 minor divisions across full-scale. May be turned off using front panel switch. |
| **Channel Grid Formats** | Two 50 division grids or one 50 division overlapping grid printed simultaneously with waveform data |
| **Frequency Response** | DC to 500Hz full-scale, -3dB |
| **Chart Motor Type** | Stepper, crystal-referenced |

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| **Linearity** | Within 0.2% full-scale |
| **A/D Resolution** | 10 bit |
| **Signal Conditioning** | Accepts ASC-900 Series or ASC-800 Series signal conditioners to cover an input range from 50μV to 2000V full-scale |
| **Signal Input** | Varies with signal conditioners used |
| **Inputs** | Two front panel 5-Way binding posts or two front panel 15-contact D-shell connectors |
| **Gain Control** | Front panel potentiometer with CAL indent setting |

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| **"Talking" Signal Conditioner Feature** | When used with all ASC-900 Series signal conditioners except the ASC-912, signal conditoner settings are automatically printed in the interchannel buffers. |
| **Zero Control** | Full-scale (± 55%) via front panel potentiometers that allow baseline to be positioned anywhere on the grid |
| **Operating Temperature Range** | 0-45°C, 5-95% RH |

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|---|---|
| **Chart Speed Accuracy** | WITHIN 2% |
| **System Log** | Alphanumeric channel prints the time, date, chart speed, and time scale at regular intervals. Time, date, and a 4-digit ID for each channel can be set by front-panel mounted switches. |
| **Event Markers** | Two event markers are provided: a system event marker and an external event marker. The external event marker is activated by external TTL Lows or switch closures. The system event marker can be activated by either the front panel MARK pushbutton or the internal timer. |

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| **Timer** | Provides timing marks at 1 minute or 1 second intervals. Switch selectable and independent of the chart speed. Displayed on the right hand marker. |
| **Operating Modes** | Operates from AC line, internal battery, or external 11-18 VDC |
| **Power Requirements** | 120/240 VAC, 48-440 Hz, or 11-18 VDC |
| **Battery Charger/ Power Supply** | Built-in charger recharges battery during AC line operation. A low battery indicator is mounted on the front panel. Power supply has capacity to operate unit from 110/220 volt source. |

| | |
|---|---|
| **Battery** | Rechargeable gel-type, factory installed. Provides approximately 2-3 hours of operation. Separate lithium cell provides a 5-year backup of time and date settings. |
| **Weight** | 37 lbs / 16.65 kg with batteries<br>26 lbs / 11.70 kg without batteries |
| **Dimensions** | 12" H x 10" W x 13.25" D<br>30.48-cm H x 25.4-cm W x 33.66-cm D |
| **Manufactured** | United States of America |
| **Warranty** | 2 years |

4. **Open the case and remove the cover by sliding it to your right. This will cause the pin-hinges to separate and free the cover from the case. Set the cover aside. Refer to figure 2-2 when performing steps 5 through 9 below.**

5. **Stand the DASH II so that the recorder is upright and facing you. The recorder's faceplate is readable and the hinges of the case are to your left.**

6. **Using a flat-blade screwdriver, loosen the four captive screws that secure the recorder's faceplate and attached electronics to the case. As you loosen the screws, you will feel them become free.**

7. **Carefully remove the faceplate with its attached electronics from the case of the DASH II. When these are separated, you will notice that the faceplate and its attached electronics are still connected to the interior of the case by three wire harness assemblies.**

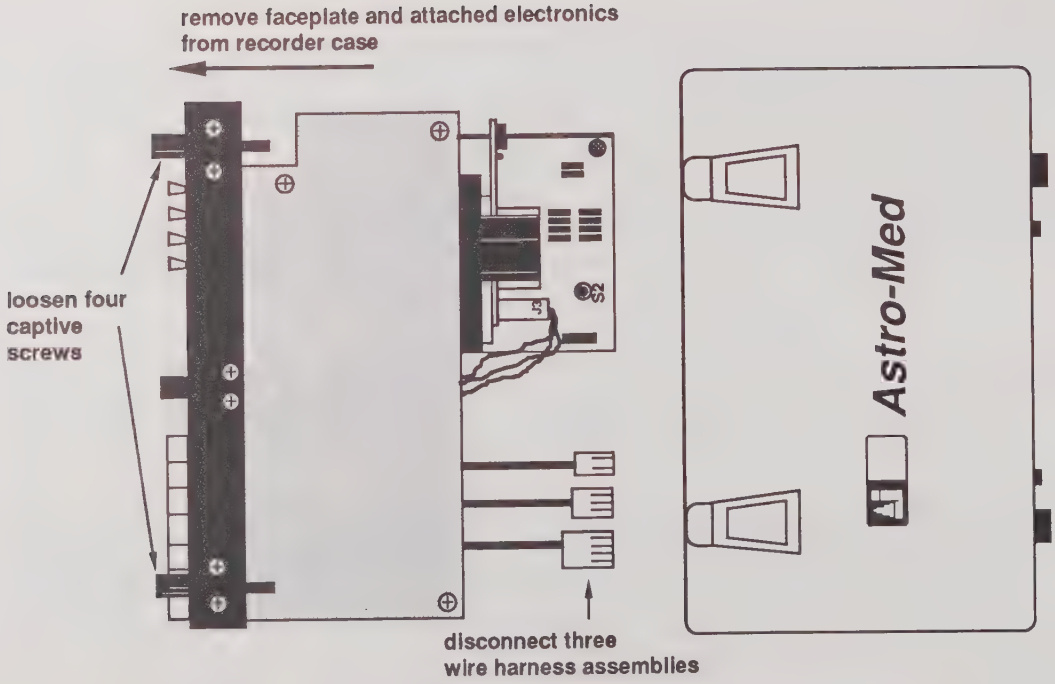



Figure 2-2. Removal of Faceplate and Attached Electronics

**CAUTION**

Always use great care when working inside the recorder case. If a tool touches the contacts of either the power-supply capacitor or the 12-volt batteries, damage could result to both the recorder and the tool. AVOID TOUCHING these contacts when working inside the recorder case.

8. **Reach into the case and separate each of the male/female connections that join each harness assembly. You will notice that the male-ends of the harness assemblies are labeled P1 (2 pins), P2 (4 pins), and P3 (3 pins). The female ends are labeled J1 (2 sockets), J2 (4 sockets), and J3 (3 sockets). Each end can mate only with its appropriate counterpart.**

9. **The faceplate and its attached electronics are now physically disconnected from the recorder's case. Put them aside. Principal components housed in the interior of the case are shown in figure 2-3.**

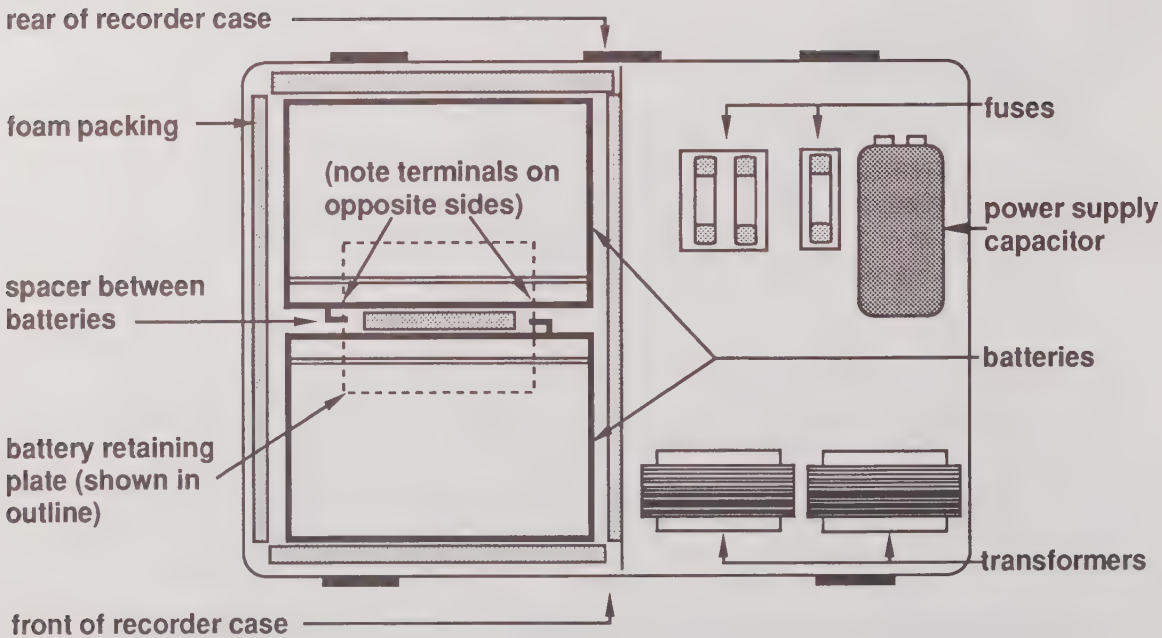



Figure 2-3. Simplified Interior of Recorder Case

### 2-8.1 Internal Fuse Replacement

1. **Perform the procedure described in paragraph 2-8, "Accessing the Recorder's Batteries and Internal Fuses".**

2. **Reorient the case of the DASH II so that it rests on its rubber feet with its latches facing you. The recorder's two 12-volt batteries and three interior fuses are exposed and accessible at the bottom of the case. The location of the fuses is shown in the figure 2-4.**

3. **Use a fuse puller or insulated screwdriver to remove the blown fuse. Push the replacement fuse securely into position in the fuse clip.**

4. **Follow the reassembly procedure provided in paragraph 2-8.4, "Reassembly After Battery/Fuse Replacement."**

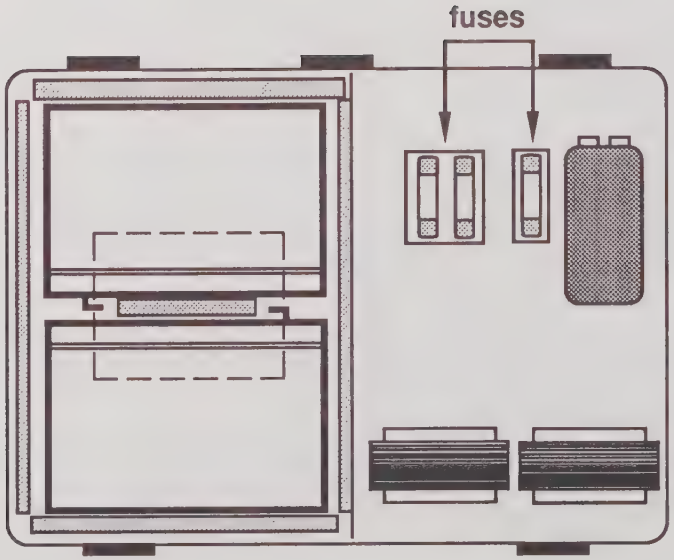



Figure 2-4. Simplified Recorder Case Interior: Internal Fuse Location

### 2-8.2 Battery Removal

1. **Perform the procedure described in paragraph 2-8, "Accessing the Recorder's Batteries and Internal Fuses." Refer to figures 2-3 and 2-5 when performing steps 2 through 6 below.**

2. **Using a flat-blade screwdriver, remove the two screws that secure the metal plate holding the batteries in place. Set the screws aside. Note that two wires run across the top of this metal plate and are attached to the plate by a plastic tie wrap.**

3. **Using a wire cutter or scissors, carefully snip the tie wrap. Be sure that you do not cut the attached battery wires.**

4. **Remove the metal retaining plate and set it aside. The batteries are now exposed. Note that the batteries are positioned on their long sides with their contacts facing in toward one another but at opposite ends. (See figure 2-3.)**

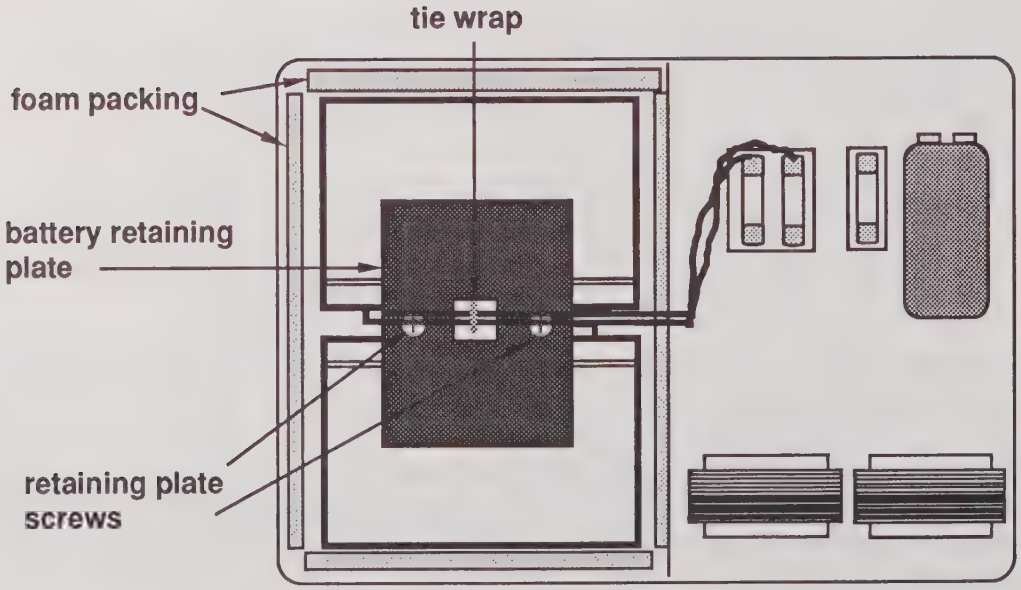



Figure 2-5. Simplified Recorder Case Interior: Battery Removal

5. **Remove the foam packing around the batteries and the aluminum plate from between the batteries. Set the packing and the plate aside.**

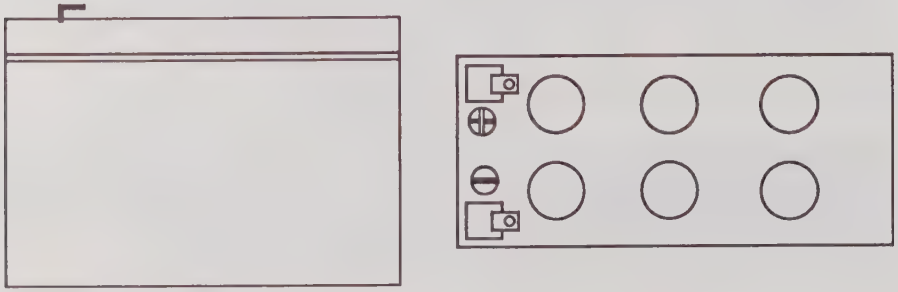
6. **Grasp the battery furthest away from you and stand it upright so that you are looking down at the battery terminals. Note that two wires are clipped to the battery terminals. These wires are longer than those attached to the remaining battery because these are the wires that run across the top of the plate that secures both batteries. The wires connected to the batteries are firmly attached. Disconnect the battery, remove it from the recorder case, and place it aside. Repeat this process with the remaining battery.**

### 2-8.3 Battery Replacement/Reinstallation

1. **Perform the procedures described in paragraphs 2-8, "Accessing the Recorder's Batteries and Internal Fuses," and 2-8.2, "Battery Removal."**

2. **Attach the long set of wire leads to the replacement battery and lay the battery on its long side, terminals facing inward and to your left. See the figure 2-3.**

*The battery terminals are labeled (+) for positive and (-) for negative. The wire leads are color coded: orange for positive and black for negative. Connect the orange (positive) lead to the positive terminal (+ ). Connect the black (negative) lead to the negative terminal (- ).*



side view top view

3. **Repeat this process with the second battery. When placing the second battery in position on its side, ensure that its terminals face inward and to your right. The terminals SHOULD NOT adjoin the terminals of the other battery. See figure 2-3.**

4. **Reposition the aluminum spacer between the two batteries and put the foam packing back into place around the batteries.**

5. **Reposition the plate that secures the batteries. Ensure that the long lead wires run over the plate after the plate has been positioned.**

6. **Reinsert the two screws that secure the battery retaining plate and ensure that they are firmly tightened.**

7. **Use a tie wrap to hold down the terminal wires running across the top of the plate.**

### 2-8.4 Recorder Reassembly After Battery/Fuse Replacement

Use the procedure given below to reassemble your recorder after changing the recorder's fuses or batteries. Refer to figure 2-6 on the following page when performing this procedure.

1. **Stand the recorder case on end so that the batteries are at the bottom of the upturned case. The hinges will be on your left.**

2. **Stand the recorder's faceplate and its attached electronics so that the faceplate is upright and readable. Position the assembly close to the upright case as shown in figure 2-6.**

3. **Three male-ended harness assembly halves (P1, P2, and P3) extend from the faceplate and its attached electronics. Connect these three ends to their female counterparts (J1, J2, and J3) in the recorder case.**

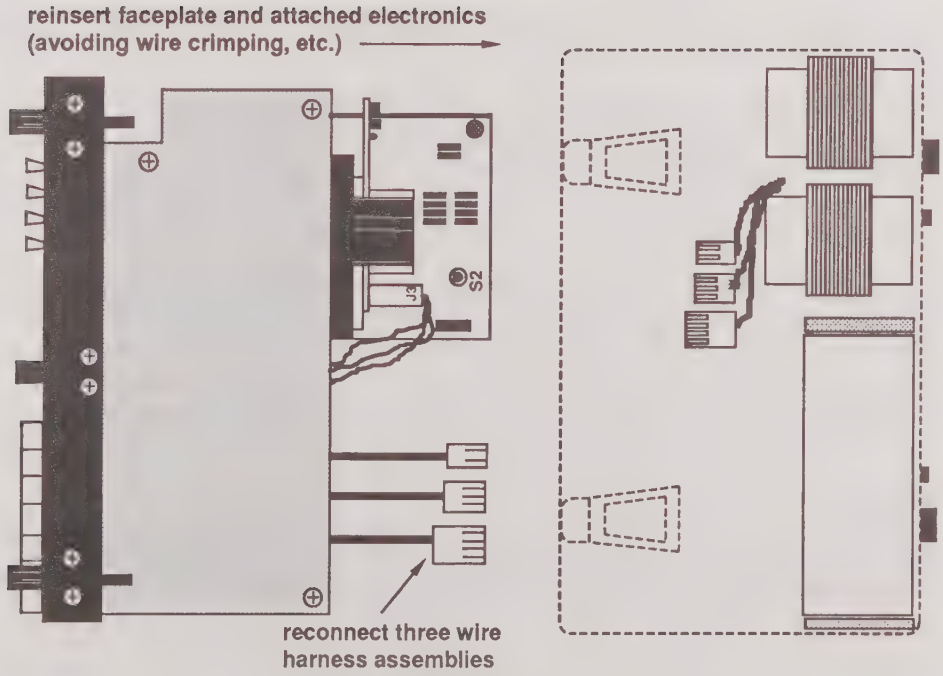



Figure 2-6. Recorder Reassembly

4. **Carefully insert the faceplate and its attached electronics into the recorder case.**

   *Be sure that no wiring is crimped, detached, or damaged in the process of inserting the faceplate and attached electronics.*

5. **Position the case and the reinserted faceplate so that the case rests on the four rubber feet of its bottom. Ensure that the faceplate and its attached electronics are fully reinserted into the case. Reinsert the four captive screws of the faceplate into their mating brackets in recorder case. Tighten the screws to complete the reattachment of the faceplate and its attached electronics to the recorder case.**

6. **Reattach the recorder's cover to the reassembled case by slipping the cover's three male half-hinges into the three female half-hinges of the case assembly. Reassembly is complete.**

## 2-9 Setting the Year

A lithium cell with a five-year life provides backup of data printed in the system log: time, date, chart speed, and time scale. Consequently, the need to change the reading of the year should be minimal. However, should the need arise, use the procedure below to change the year setting that appears on the system log.

1. **Ensure that the DASH II is unplugged and disconnected from all power sources. In addition, ensure that the POWER switch is set to "off" (0).**

2. **Place the DASH II on a table or area suitable for the disassembly of the recorder.**

3. **Orient the DASH II so that it rests on its rubber feet (bottom) with the latches of the case facing you.**

4. **Open the case and remove the cover by sliding it to your right. This will cause the pin-hinges to separate and free the cover from the case. Set the cover aside.**

5. **Stand the DASH II so that the recorder is upright and facing you. The recorder's faceplate is readable and the hinges of the case are to your left.**

6. **Using a flat-blade screwdriver, loosen the four captive screws that secure the recorder's faceplate and attached electronics to the case. As you loosen the screws, you will feel them become free.**

7. **Carefully remove the faceplate with its attached electronics from the case of the DASH II. When these are separated, you will notice that the faceplate and its attached electronics are still connected to the interior of the case by three wire harness assemblies.**

8. **Set the two right-most pushbutton switches of the system log controls (paragraph 3-3.5, figure 3-3) to the last two numbers of the year that you want printed in the system log. For example, 95 would indicate 1995 or any century ending in 95. Only the last two digits are significant.**

9. **Set the front-panel POWER switch to "on" (|) so that the recorder is powered by its batteries.**

10. **With the faceplate and its attached electronics removed from the recorder case but still connected to the case by three wire harnesses, press the S2 button located on the power supply board. This sets the system log to the year that you specified. See figure 2-7.**

11. **Set the POWER switch to "off" (0) and reinsert the faceplate and its attached electronics into the recorder case. Reinsert and tighten the four captive screws that join the faceplate to the recorder case.**

12. **Reattach the cover to the assembled recorder.**

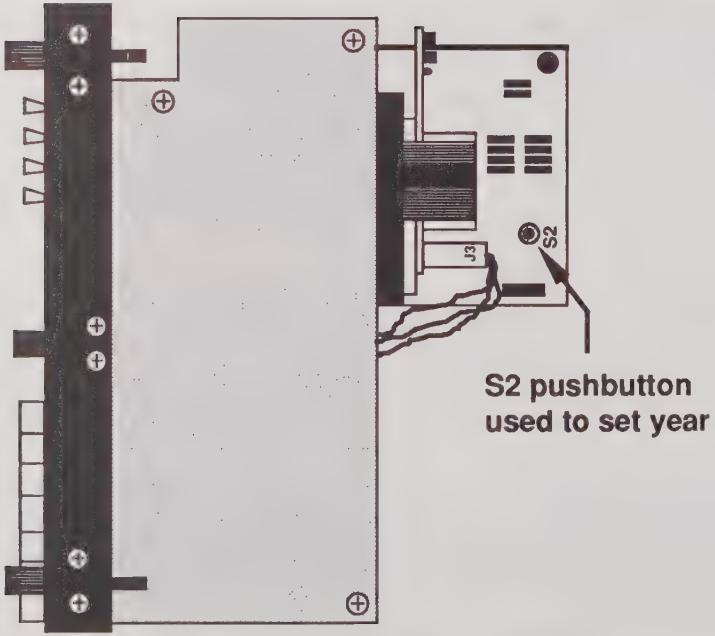



Figure 2-7. Location of Year-Set Pushbutton

# Section 3
# Operation

## 3-1 General Information

Before actually using your DASH II recorder in any given task, you should familiarize yourself with the recorder's physical controls, indicators, and connections.

Paragraphs 3-2 and 3-3 introduce you to the basic hardware features of the recorder. Understanding the purpose and function of each feature will allow you to quickly master this versatile and user-friendly instrument.

You should also acquaint yourself with the controls of the two signal conditioners required to operate the recorder. Refer to the Operations Manuals that come with your signal conditioners for information regarding signal-conditioner features.

## 3-2 Case Description

The DASH II recorder is housed, protected, and carried in a rugged 14-gage, drawn aluminum case. The dimensions of the case are 12" H x 10" W x 13.25" D. The case has a removable cover.

The removable cover is attached to the case by three separable pin hinges and secured by two front latches. This makes the cover easy to remove from the base. Figures 3-1 and 3-2 illustrate the DASH II in its aluminum case.

The AC power cord used for AC line operation is wound around a cord winder inside the cover for storage.

The base that houses the recorder contains the power supply, two rechargeable gel-type batteries (factory installed), and a battery charger. The batteries are placed at the bottom of the case in formed, protective polyurethane foam. A neoprene gasket around the top of the case seals the recorder when the cover is closed. This helps to ensure a dust and moisture resistant environment for the closed recorder.

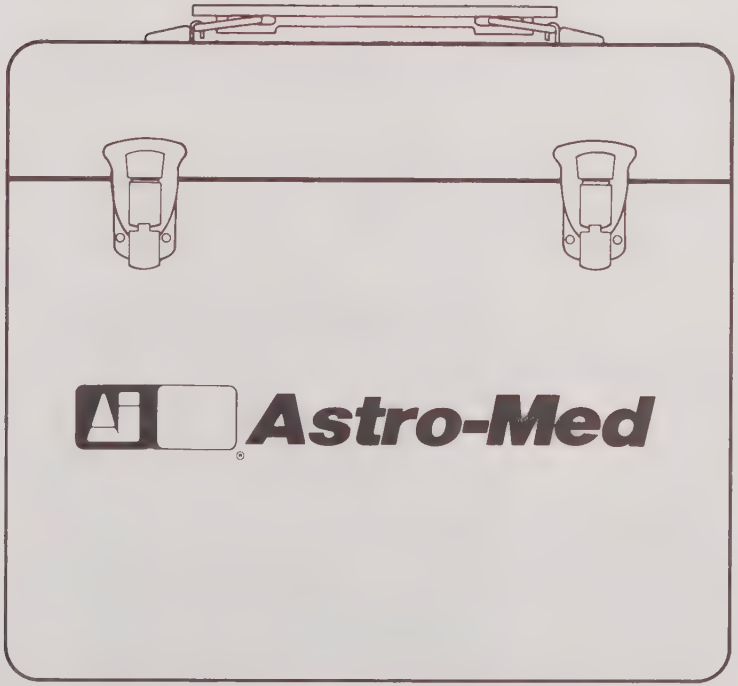



Figure 3-1. DASH II Aluminum Case (Latch Side)

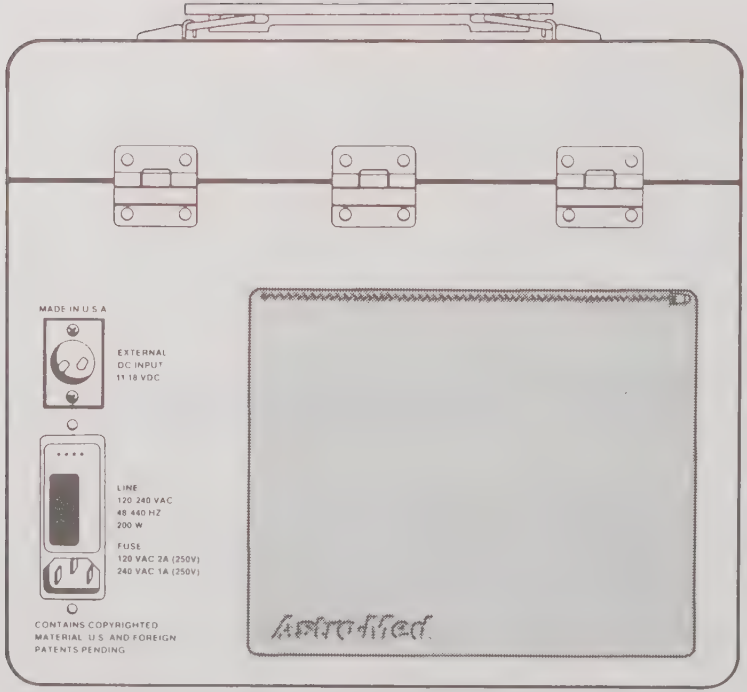



Figure 3-2. DASH II Aluminum Case (Hinge Side)

Two power-input receptacles and the power entry module are located on the exterior of the hinged side of the case (figure 3-2).

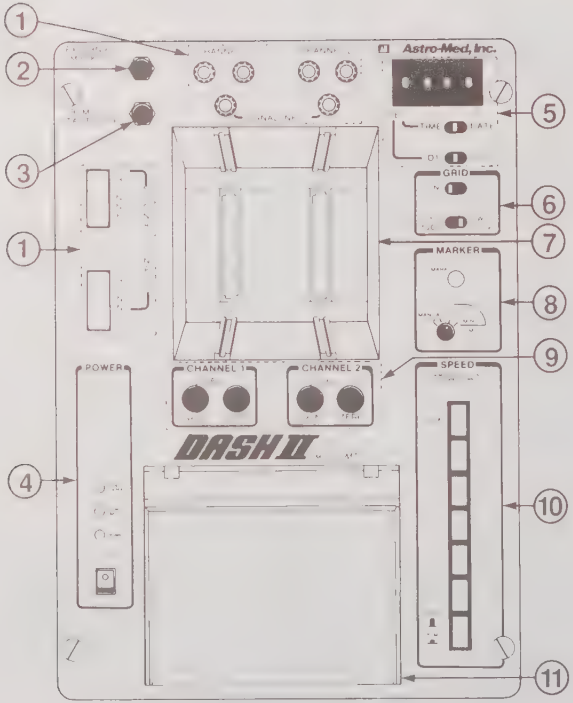
Power can be supplied to the recorder either through an external three-contact DC-input jack or through a three-prong male AC line jack.

***See section 2, "Hardware Setup," for information regarding changing fuses and arranging the voltage selection card.***

Fully assembled, the DASH II recorder weighs 34 lbs and measures 12" H x 10" W x 13.25" D (30.48-cm H x 25.4-cm W x 33.66-cm D).

## 3-3 Front Panel Controls

Figure 3-3 is provided to simplify the following description of the switches and front-panel features of the DASH II. The features in the illustration are numbered for convenient reference in the paragraphs that follow. The paragraphs below define the function of each DASH II front-panel feature. The circled numbers that appear in the headings below correspond both to the numbered call-outs of figure 3-3.




| | |
|---|---|
| 1 | Signal Input |
| 2 | External Marker Jack |
| 3 | Remote Start/Stop Jack |
| 4 | Power Status Features |
| 5 | System Log Controls |
| 6 | Grid Selection Controls |
| 7 | Signal Conditioner Card Cage |
| 8 | Marker Controls |
| 9 | Signal Adjustment Controls |
| 10 | Speed Selection Controls |
| 11 | Paper Chamber |

Figure 3-3. Front Panel Controls

### 3-3.1 Signal Input (1)

For the purpose of signal input, the DASH II is equipped with two 15-pin D-shell connectors and two 5-Way binding posts. Both inputs carry signals from an external source to the two signal conditioners installed in the recorder. However the inputs cannot be used simultaneously. Use the method of signal input that best suits your application.

The two 15-pin D-shell connectors are located to the left of the signal conditioners. They are vertically oriented, one above the other. Each connector is easily identified by the corresponding channel number screened on the panel: SIGNAL INPUT CHANNEL 1 and CHANNEL 2.

The 5-Way binding posts located directly above the signal conditioners provide an alternative to the D-shell connectors for signal input. However, the binding posts cannot be used with all signal conditioners. In addition, you must supply banana jacks for use with the binding posts.

See paragraph 2-6 for additional signal-input information.

### 3-3.2 EXTERNAL MARKER Jack (2)

The EXTERNAL MARKER jack, located in the upper left corner of the front panel, accepts a 1/4" three-conductor phone plug provided with the recorder. Insertion of the phone plug causes an external event marker line to be printed continuously at the left edge of the chart paper. Appendix D provides representative samples of DASH II charts that identify the chart features discussed here and throughout this manual. The external event marker line will only appear when the phone plug is inserted in the EXTERNAL MARKER jack. (The external event marker line is separate and distinct from the system event marker line continuously printed to the left of the channel 2 grid.) The phone plug allows you to input external TTL lows and provides a mechanism for the implementation of switch closures. Either of these alternatives provides an externally generated means of marking the location of data that you consider significant by causing the event marker line to deflect to the left.

In this way the data are "marked" for later analysis. The external event marker line returns to its original position when the switch is released or when the TTL low concludes. The marker disappears when the phone plug is removed from the jack.

### 3-3.3 REMOTE START/STOP Jack (3)

The REMOTE START/STOP jack accepts a 1/4" three-conductor phone plug identical to that of the EXTERNAL MARKER jack. This jack is also provided with your recorder. With this phone plug wired and inserted into the REMOTE START/STOP jack, you can start and stop the chart drive without using the front panel controls. When the phone plug has been inserted into the REMOTE START/STOP jack, the DASH II is placed into remote start/stop operation. The recorder will cease running until it receives a switch closure through the phone plug.

### 3-3.4 Power Status Features (4)

The power status controls and indicators are located in the lower left corner of the control panel. They consist of the power on/off switch and three LED indicators—**CHECK PAPER, LOW BATT,** and **POWER**.

- When the power switch is in the "on" position (the switch is up), the green LED labeled POWER is illuminated.
- The red LED labeled LOW BATT illuminates to indicate a weak battery condition.
- The yellow LED labeled CHECK PAPER illuminates to alert you to adjust/refill the thermal paper supply or to ensure that the paper chamber door is completely closed.

### 3-3.5 System Log Controls (5)

The System Log controls are located in the upper right corner of the control panel. The controls consists of:

- Four adjacent push-button switches that together form a 4-digit numeric display
- **TIME/DATE SET** switch
- **ID1 / ID2 SET** switch

These controls are used to program the time, date, and a 4-digit identification (ID) number for each channel. The programmed information can then be printed in buffers that appear to the left of each channel during two-grid recording. Appendix D provides sample DASH II charts that highlight the chart features discussed below.

The buffer for channel 1 is located on the far left of the chart paper as viewed from the front of the recorder. The channel 1 buffer functions as the system log. The programmed time and date will appear in this buffer.

The buffer for channel 2 is located in the center of the chart paper. During overlap recording, the buffer for channel 1 is printed to the left of the single grid and the buffer for channel 2 is printed to the right.

The four push-button switches are adjacent to each other and form a 4-digit numeric display. The display is used in conjunction with the ID1 / ID2 switch. When the ID1 / ID2 control is pushed, this four number display is printed in the corresponding interchannel buffer: ID1 for channel one and ID2 for channel two. Each switch of the four number display is operated by means of two pushbuttons. One pushbutton is above the digit and one is below the digit. Pressing the top pushbutton decreases the digit. Pressing the lower pushbutton increases the digit. Refer to paragraph 3-4.3.3 for information regarding setting each channel's ID number.

The **TIME/DATE SET** switch is used to program the recorder's internal time and date. For information regarding the setting of time and date, see paragraph 3-4.2.

The **ID1 / ID2 SET** switch causes the 4-digit, user-specified identification number to be printed in either of the recorder's two interchannel buffers. If the switch is pressed toward the ID1 setting, the four digit ID will appear in the interchannel buffer of channel 1. If the switch is pressed toward the ID2 setting, the four digit ID will appear in the interchannel buffer of channel 2.

### 3-3.6 Grid Selection Controls (6)

The grid selection controls are located directly below the ID1 / ID2 SET switch. The controls consists of a grid **ON/OFF** switch above a grid selection switch.

The ON/OFF switch determines whether or not a grid will be printed on the chart paper.

The ONE 50 DIV / TWO 50 DIV grid selection switch gives you a choice between a single 50-division overlapping grid or two 50 division grid channels. When operating in the one-grid mode, the recorder expands and overlaps the waveforms from both signal conditioners on a single grid.

*See appendix D for representative examples of the DASH II's grid options.*

### 3-3.7 Signal Conditioner Card Cage (7)

The DASH II built-in signal conditioner card cage accomodates two ASC-900 series signal conditioners of your choice. (Although they are no longer manufactured, ASC-800 series signal conditioners can also be used with the card cage.)

**NOTE**

The DASH II will not record waveforms unless signal conditioners are present and properly installed in the recorder's built-in card cage.

### 3-3.8 Marker Controls (8)

The MARKER controls consist of a manual pushbutton labeled MARK and a four-position rotary TIMER switch. Each of these controls utilizes the system event marker line to identify data of interest to you. Don't confuse the system event marker line with the external event marker line. The external event marker line is always the line printed at the extreme left of the chart paper as viewed from the recorder's front. (See appendix D.)

The external event marker line is only printed when the external-event phone plug is inserted in the EXTERNAL EVENT phone jack. When the phone plug is removed, the external event marker line stops being printed. (See paragraph 3-3.2 above.) During two-grid operation, the system event marker line is printed in the interchannel buffer of channel 2 (near the center of the chart). During overlap operation, the system event marker line is printed near the left edge of the chart paper in the interchannel buffer of channel 1.

- When you push the MARK pushbutton, the system event marker line deflects to the left to mark data of interest to you. When you release the MARK pushbutton, the system event marker line returns to its original position. The MARK pushbutton is only functional when the TIMER switch is set to MANUAL, 1 SEC, or 1 MIN. The MANUAL pushbutton takes precedence over the 1 SEC and 1 MIN setting of the TIMER switch. When the TIMER switch is set to OFF, the MANUAL pushbutton is disabled.

- The TIMER switch is a rotary switch labeled OFF, MANUAL, 1 SEC, 1 MIN. When this control is used, a timing mark appears on the system event marker line at the time interval selected: either one second or one minute. The mark is a small, horizontal spike on the system event marker line.

### 3-3.9 Signal-Adjustment Controls (9)

The signal-adjustment potentiometers provide real-time waveform trace position controls and signal-strength controls for the two recording channels of the DASH II. The controls are labeled CHANNEL 1 and CHANNEL 2.

Each channel has two controls placed adjacent to one another: a ZERO potentiometer and a GAIN potentiometer with a CAL (calibrated) indent setting.

For each channel, the ZERO and GAIN/CAL controls are used to:

- position the real-time trace within the channel
- establish the real-time waveform trace in a calibrated grid
- vary the gain applied to the signal on the trace to expand or reduce the appearance of the real-time trace *(This affects the recorded waveform rather than the input signal.)*

**ZERO** The ZERO control is used to shift the real-time waveform trace of an input signal to any position within the selected channel. In using this control, you will probably want to ground the signal as it is input into the recorder to obtain a flat-line trace. You can do this simply by turning the signal conditioner OFF for the particular channel being adjusted.

The zero-baseline trace can then be easily centered or shifted by rotating the ZERO control knob in the direction of the desired left or right shift. When you have positioned the zero baseline, you can recover the real-time waveform trace by turning the signal conditioner ON.

**GAIN/CAL** The GAIN/CAL control functions in two ways. When rotated in the GAIN range, this potentiometer applies a variable fractional gain to the signal on the trace, that is, the GAIN control affects the recorded waveform rather than the input signal. As gain is increased or decreased, the appearance of the real-time waveform trace expands or contracts. GAIN approaches its maximum as the potentiometer is moved toward the CAL setting.

**GAIN/CAL** (cont.) When set to CAL, the switch causes a precise, factory-set gain to be applied to the input signal. Because the gain has been fixed to a known quantity, each block of the grid that is printed with the real-time waveform takes on precise value with reference to the attenuator settings of the signal conditioners.

### 3-3.10 Speed Selection Pushbuttons (10)

The Speed Selection controls consists of seven pushbutton speed-selection switches. These pushbutton switches are rectangular in shape and placed vertically one above another. They are located along the lower right side of the front panel. The purpose of the speed selection controls is to enable you to set the speed at which the chart paper will run.

The top six switches are labeled in descending order: 100, 50, 25, 10, 5, 1. The numbers indicate the chart speed that will be set when the corresponding pushbutton is pressed. The chart speed is the sum of all pushbuttons pressed. A total of 70 speeds can be obtained ranging from 1 mm/min to 100 mm/sec.

When any pushbutton is pressed, it changes to the color orange to indicate that this speed has been selected and is engaged. When pressed, the pushbutton will remain in an indented position until it is released by being pressed again.

The bottom switch in the group is labeled **mm/MIN—mm/SEC**. This pushbutton determines whether chart-paper speed will be set for millimeters per minute (mm/MIN) or millimeters per second (mm/SEC).

Pressing the switch sets the recorder to operate in the mm/MIN mode and changes the color of the switch to orange. When the pushbutton has not been pressed and is left in its extended position, the recorder is set in the mm/SEC mode. In its extended position, the color of the pushbutton is black.

### 3-3.11 Chart Paper Chamber (11)

The paper chamber is centered in the lower half of the recorder. The chamber measures 2-1/2" H x 5"W x 6" D (6.35-cm H x 12.7-cm W x 15.24-cm D). The paper chamber door is hinged at the bottom and provides easy access for paper loading. The chamber accepts Astro-Med thermal Z-fold paper. See paragraph 3-4.1 below for a detailed explanation of how to load your recorder with paper.

## 3-4 Recorder Setup

Before operating your recorder, you must complete all of the applicable installation procedures described in section 2, "Hardware Setup." When you have prepared your DASH II for operation and have familiarized yourself with its connections and controls, you can prepare the instrument for recording.

To prepare for recording: (1) load the recorder with Z-fold thermal paper, (2) turn the recorder on, (3) set the time and date of the instrument's internal clock and calendar, and (4) establish the desired operational setups. Each of these setup procedures is described below.

### 3-4.1 Loading Z-Fold Thermal Paper

Loading the recorder with a pack of Z-fold thermal paper is illustrated in figure 3-5. The recorder can be either on or off during the paper loading procedure. Perform the step by step instructions that follow to insert and position the paper.

1. **Remove the Z-fold thermal paper from its box.**

2. **Open the paper-chamber door.**

3. **Place the paper into the paper chamber making sure that the directions stamped on the Z-wrap are upright and oriented for normal reading.**

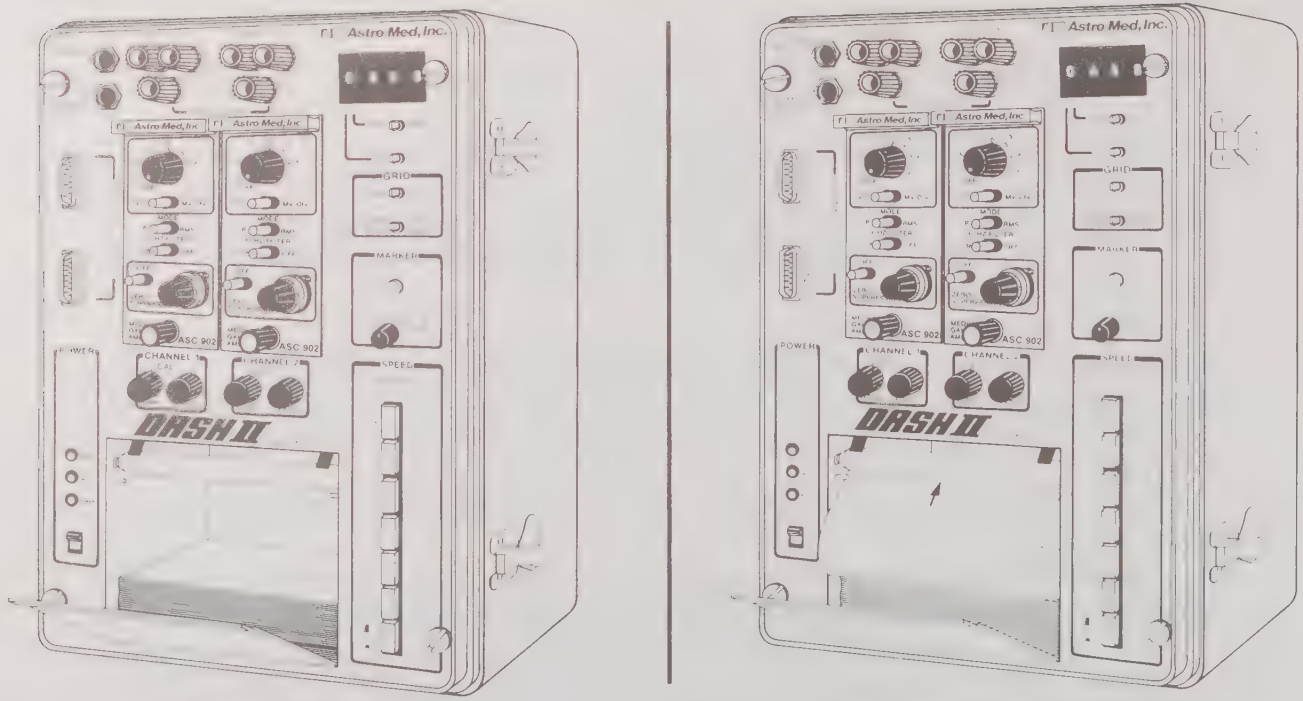
4. **Remove the wrapper from the paper and discard it.**

5. **Pull the top sheet of the paper pack out of the paper chamber.**

6. **Insert the top sheet into the slot beneath the drive roller.**

7. **Manually feed the paper into the recorder and around the drive roller by carefully pushing the paper forward.**

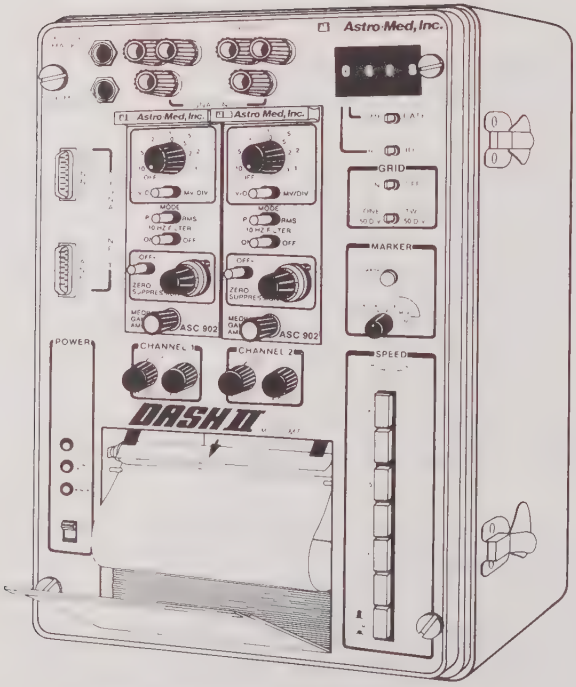
8. **Push the paper forward until it passes over the drive roller and begins to exit the recorder above the drive roller.**



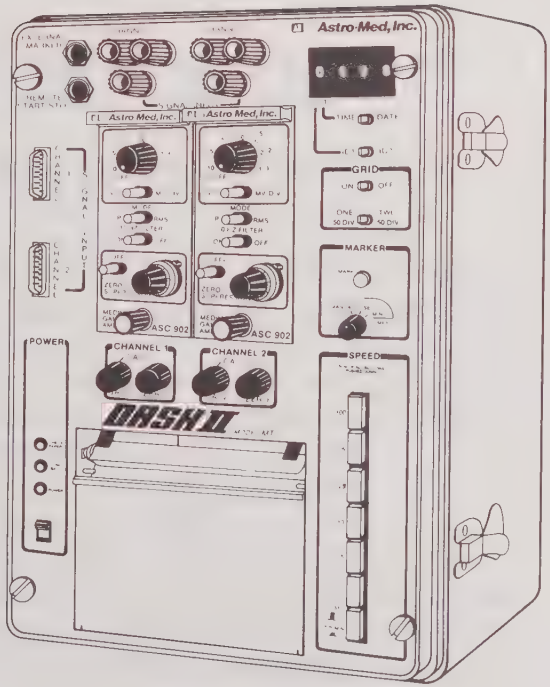

put paper into chamber

insert paper beneath drive roller

Figure 3-5. Loading Recorder With Z-Fold Thermal Paper




paper exits above drive roller




close paper-chamber door

Figure 3-5. Loading Recorder With Z-Fold Thermal Paper (continued)

9. **When the paper begins to exit the recorder, evenly pull out several inches.**

10. **Ensure that the chart-paper pack is fully inserted into the paper chamber by pushing it to the rear of the chamber.**

11. **Hold the paper lead out of your way and close the paper chamber door. The recorder is now loaded with a pack of thermal Z-fold chart paper.**

12. **If you have loaded the paper with the recorder turned off, turn the recorder on by setting the power switch to the "on" position ("I" showing).**

    *The green LED indicator (POWER) will be illuminated.*

    *If the paper chamber door has not been fully closed, the yellow LED indicator, CHECK PAPER, will be illuminated.*

13. **Push any speed selection button to run the chart paper briefly. This will ensure that the chart paper is tracking properly.**

### 3-4.2 Time and Date: Programming the Recorder's Internal Clock and Calendar

The four push-button code switches of the system log group (3-3.5) and the **TIME/DATE SET** switch are used to program the time and date of the recorder's internal clock and calendar. The internal clock and calendar determine the time and date that appear on the system log and serve as the reference point for all recorder activities that require time and date data. Remember that the system log is printed in the channel 1 annotation buffer. This buffer appears on the left side of the chart paper as viewed from the recorder's front.

**To program the time of the recorder's internal clock**

The 4-digit display will read <0000> or will reflect the time based on the last setting of the pushbutton switches. Although you will only set the hour and minutes of the internal clock, hours, minutes, *and seconds* will be printed on the system log of the recorded chart.

1. **Press the 4 pushbutton code switches until the correct time is shown in the display.**

   *As the numbers are entered, they are displayed on the four digit display. Time must be entered in 24-hour format (hh/mm). Leading zeros must be added when entering a single digit hour or minute. For example,* 0332 (3:32 am).

2. **Press the TIME/DATE switch toward TIME.**

   *When the switch is pressed, the recorder accepts and retains the data. You can proceed. The time will be printed automatically in the system log during recorder operation.*

**To program the date on the recorder's internal calendar**

The 4-digit display will reflect the date based on the last setting of the pushbutton switches.

1. **Press the 4 pushbutton code switches until the correct date (mm/dd) appears in the display.**

   *Leading zeros must be added when entering a single-digit month or day. For example,* 0420 (April 20).

2. **Press the TIME/DATE switch toward DATE.**

   *When the switch is pressed, the recorder accepts and retains the data. You may proceed. The date will be printed automatically in the system log during recorder operation.*

> **NOTE**
>
> YEAR settings have been factory set and are automatically inserted into the system log. To adjust the YEAR setting, refer to the paragraph 2-9 of this manual.

### 3-4.3 Operating Setups

The DASH II has only four operating setups: 4-digit ID Setup, Grid Pattern Setup, Marker Setup, and Chart Paper Speed Selection Setup.

Each operating setup affects the recorded chart. Using these setups, you can:

- print a 4-digit ID number in the interchannel buffer of either channel
- turn the grid on and off
- switch between two 50-division grids and one overlapped and enlarged 50-division grid
- record a timing pulse in second or minute intervals or place manual event marker lines on the chart-paper
- set seventy chart-paper speeds from 1 mm/min to 100 mm/sec

**3-4.3.1 Time Setup.** Refer to paragraph 3-4.2 for a discussion on programming the time on the recorder's internal clock.

**3-4.3.2 Date Setup.** Refer to paragraph 3-4.2 for a discussion on programming the date on the recorder's internal calendar.

**3-4.3.3 4-Digit ID Setup.** Setting the four pushbutton switches of the 4-digit ID allows you to establish an arbitrary 4-digit code number that will be printed in a selected annotation buffer. This number can stand for anything you wish. For example, experiment 0052, valve number 1163, etc. The 4-digit code will appear in the annotation buffer of whichever channel is selected when the ID1 / ID2 momentary switch is used. If this switch is pushed in the direction marked ID1, the code will appear in the channel 1 annotation buffer. If the switch is pushed in the direction marked ID2, the code will appear in the channel 2 annotation buffer. The 4-digit number will continue to be printed in the selected annotation buffer until the recorder is shut off. Appendix D shows the 4-digit ID as it appears on the printed chart. Use the steps that follow to program the 4-digit ID.

1. **Press the pushbutton switches until the 4-digits you desire appear in the front-panel display.**

2. **Press the ID1 / ID2 momentary switch to enter the data into the selected channel's annotation buffer.**

**3-4.3.4 Grid Pattern Setup.** *(See appendix D for chart samples that show the recorder's various grid options.)* The GRID controls set:

- grid ON or OFF
- two 50-division grids or one overlapped and expanded 50-division grid

Follow the steps given below to have a grid printed and set the grid pattern.

1. **Press the GRID ON/OFF switch to specify whether or not you want the grid printed.**

2. **Press the channel switch labeled ONE/TWO to select the grid format of your choice.**

**3-4.3.5 Marker Setup.** The marker setup uses the controls of the MARKER group to:

- cause the system event marker line to deflect to the left by manually pressing the MARK pushbutton and so identify events that you find significant.

- automatically print timing pulses along the system event marker line at intervals of either one second (1 SEC) or one minute (1 MIN).

**Press the manual MARK pushbutton at your discretion to deflect the system event marker line to mark data of interest to you or have the recorder automatically print timing pulses as described below.**

**Turn the TIMER switch to the time interval setting of your choice to initiate automatic printing of timing pulses.**

*The MANUAL pushbutton takes precedence over the 1 SEC and 1 MIN setting of the TIMER switch. When the TIMER switch is set to OFF, the MANUAL pushbutton is disabled.*

**3-4.3.6 Chart-Paper Speed Selection Setup.** The speed selection setup sets the speed at which the chart-paper runs. Follow the steps given below to set the speed.

1. **Press the mm/SEC—mm/MIN switch to specify whether you want the chart-paper to run in millimeters per second or millimeters per minute.**

   *Pressing the switch in causes its color to change to orange. Orange indicates the recorder is set in the mm/MIN mode.*

   *When the pushbutton is black, the recorder is set in the mm/SEC mode.*

2. **Press the numbered speed-select pushbuttons for the desired chart speed. When pressed, selected switches will turn orange.**

   *The chart speed is the sum of all buttons pressed. 100 mm/second is the maximum speed. A total of 70 speeds can be obtained.*

### 3-4.4 Use of the External Marker Jack

The EXTERNAL MARKER jack accepts either of the 3-contact phone plugs provided with the DASH II. You must wire the phone plugs that come with the DASH II. Wiring of these phone plugs is fully described and illustrated in paragraph 2-4.2. When the phone plug is inserted into the EXTERNAL MARKER jack, an external event marker line is printed on the far left of the chart paper as viewed from the recorder's front. This line is seperate and distinct from the system event marker line. Insertion of the phone plug enables you to mark significant events on the external event marker line through either an external TTL low or a switch closure. Each of these conditions will cause the external event marker line to deflect to the left. When the phone plug is removed from the EXTERNAL MARKER jack, the external event marker line ceases to be printed.

### 3-4.5 Use of the Remote Start/Stop Jack

The REMOTE START/STOP jack accepts either of the 3-contact phone plugs provided with the DASH II. The jack and phone plug provide an alternative to the recorder's front-panel start/stop controls. You must wire the phone plugs that come with the DASH II.

Wiring of these phone plugs is fully described and illustrated in paragraph 2-4.2. When the phone plug is inserted into the REMOTE START/STOP jack, the recorder will cease to run until placed into operation by recieving a switch closure through the phone plug.

## 3-5 Operating the DASH II

In this manual, we have:

- discussed the hardware setup of the DASH II
- identified and talked about all of the recorder's front-panel control features
- explained the operational setups of the recorder
- discussed how to change the recorder's operational setups to the settings you desire

When you have dealt with each of these aspects of the DASH II, very little remains to be done. Simply apply power to the recorder, input a signal or signals into the recorder, and set the controls of your signal conditioners to the positions desired. The instrument will begin to record the signals you have input.

Congratulations. Your DASH II is operational and ready for years of rugged, reliable service.

# Section 4
# Theory of Operation

## 4-1 Principles of Direct Thermal Recording

Direct thermal recording is used to print the waveform representations and alphanumeric data output by the DASH II. Direct thermal recording requires:

- thermally sensitive paper
- a thermal printhead
- a method for controlling energy supplied to the printhead

A thermal printhead consists of a series of closely spaced resistive elements mounted on a nonconductive material. The assembly is coated with a protective glaze and mounted on a heat sink.

A platen holds the thermal paper against the glaze. The platen is made of a soft material that ensures uniform contact between the printhead and thermal paper.

When voltage is applied to the resistive elements of the printhead, current flows and generates heat. The heat is conducted through the protective glaze to the paper. Heat is also conducted to the heat sink on which the printhead is mounted. Thermal paper darkens with the application of sufficient heat. Astro-Med thermal paper marks clearly when exposed to about 80 °C. The energy required to raise the paper surface to this temperature varies with paper speed, glaze thickness, paper temperature, element temperature, etc.

### 4-1.1 Strobe

Three factors determine the amount of energy applied to each element of the printhead: the voltage across the element; the amount of time the voltage is applied; and the resistance of the element. In response to printing conditions, the printhead controller varies both the voltage and the duration for which the voltage is applied.

This applied voltage pulse is referred to as the "strobe." The time period during which voltage is applied to the element is referred to either as "on time" or "strobe length." Strobe length is usually between 100 and 500 microseconds. The applied voltage will vary between 16 and 24 volts.

### 4-1.2 Energy Control Mechanisms

Sophisticated regulation of the energy applied to the printheads is required when using the printhead at high speeds. This is necessary to ensure trace quality, enhance printhead life, and conserve battery power. Three mechanisms are used by the recorder to regulate the energy applied to the printhead: temperature feedback, current feedback, and dot history. Temperature feedback acts to shorten the strobe length and, consequently, reduce energy flow.

The printhead controller uses the system microprocessor to monitor the temperature of the printhead. Temperature is measured by a thermistor mounted in the printhead. Increases in temperature causes the microprocessor to reduce strobe length. This reduces the amount of energy available to the printhead.

Recording multiple, full-scale, high-frequency waveforms will heat up the thermistor and therefore the strobe length will be shortened.

Current feedback provides a second mechanism for the regulation of energy in the DASH II. A current-feedback regulating mechanism is implemented in the printhead power supply. When no printing is underway, the printhead power supply is set to between 22 and 24 volts. When recording is in progress, a shunt resistor is used to monitor current flow to the printhead. The voltage across the shunt resistor is proportional to instantaneous current. The voltage across the shunt resistor is converted to a root mean square value using analog circuitry and filtered. The result is a voltage that reflects near-past energy usage of the printhead.

This voltage is used to reduce the voltage applied to the printhead. For most applications, the effect is not noticeable. The printed waveform trace can appear light or gray under printing conditions requiring large numbers of dots to be energized frequently. Combinations of high chart speed, large signal amplitude, and high input frequencies require the greatest printing energy.

Although these mechanisms limit overall or "global" energy consumption, they cannot prevent a small section of dots from being excessively energized. This is a result of thermal inertia that causes individual resistive elements to cool gradually rather than instantly. At high print rates, resistive elements may have insufficient time to cool before being re-energized.

Over several cycles, this can have the cumulative effect of raising element temperatures to unacceptable levels. Eventually, this would result in element damage.

Dot history is the mechanism used to counteract the thermal inertia properties of the print elements. The printhead controller contains dedicated circuitry that maintains records of those dots energized during previous cycles.

Information regarding the print elements to be fired during a given cycle is conditioned by the thermal history of the individual elements. A printing element experiencing heat build-up from previous firings will not be fired during successive cycles. The implementation of this simple concept is complex and takes into account the temperature of neighboring elements.

## 4-2 Chart Drive

The DASH II recorder uses a two-phase, bi-polar stepper motor to move chart paper. The resolution of the motor drive is 16 steps/mm.The essence of the motor control circuit is an integrated motor controller circuit operating in the full-step mode. This generates four phase drive signals. The motor controller circuit operates in conjunction with a dual full-bridge driver. This driver supplies drive current to the motor windings.

The frequency of pulses supplied by the DASH II microprocessor to the motor control circuit determines the speed of the chart. Two resistors (one for each set of windings) sense the current drawn by the motor. The motor controller compares the voltage across the sense resistor to a reference voltage. If current levels exceed the reference level, a pulse width modulated chopper frequency is imposed on the coil voltage. This acts to limit the current. An analog switch allows the DASH II microprocessor to select one of two current levels. This minimizes current drain at slow speeds.

## 4-3 Interlock

An infrared emitter/sensor assembly is mounted just above the paper tray. This sensor consists of an infrared emitting diode and a silicon photo transistor mounted in the plastic housing. The angles of the diode and the photo transistor are fixed. They are arranged so that a reflective surface approximately 0.12 inches away from the sensor assembly will cause the photo transistor to conduct.

When the paper chamber door is closed and the thermal paper is properly loaded, the infrared light is reflected by the paper. The reflected infrared activates a transistor sensor. The sensor data is converted to a logic level that indicates either "door open" or "no paper." The system controller monitors interlock level and causes the front-panel paper out LED to illuminate. The logic level is also used to gate the printhead strobe pulses. The printhead will not be energized during an interlock condition and the motor will not turn on. Figure 4-1 presents a typical circuit.

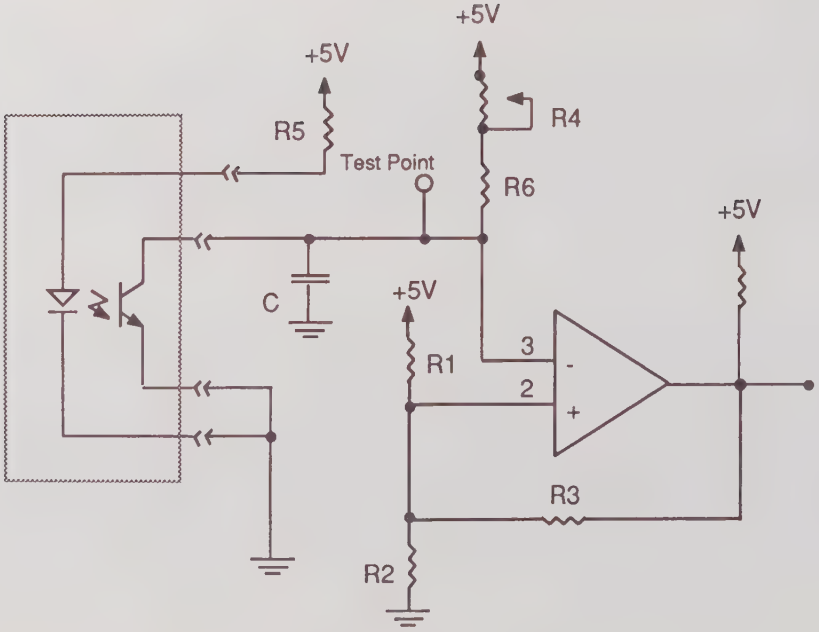



Figure 4-1. Interlock Circuit Assembly

## 4-4 Real-Time Analog Recording: Data Conversion

The following aspects of data conversion are discussed in the paragraphs below: waveform sampling and min/max recording approach.

### 4-4.1 Waveform Sampling

The DASH II records analog waveforms by (1) sampling the waveforms at high speed, (2) converting the samples into line segments, and (3) printing these segments on the chart.

The A/D converter is a high speed, 10-bit, successive approximation device. A full 10-bit conversion is performed. However, because the least significant bit is not required for recording, it is ignored.

### 4-4.2 Min/Max

The min/max algorithm emulates an ideal stylus recorder with a very high frequency response. When recording high frequencies at low chart speeds, this ideal device draws lines between the maximum and minimum input values. A pulse train appears as a sequence of lines. A sine wave appears as a solid band. Signal amplitude is reproduced correctly regardless of paper speed.

Analogously, the DASH II recorder reproduces a waveform as a series of lines. At moderate speeds, the lines are printed very close together. The resulting waveform has the appearance of a waveform produced by a traditional oscillograph having a very high frequency response. At higher speeds, limits on the printing rate may give the waveform a slightly digitized appearance.

The min/max algorithm is implemented in software. When a channel has been sampled, the result is compared to the previous maximum value for that channel. If the newly sampled data point is larger than the previous maximum value, the new data point becomes the new maximum value. Similarly, minimum values are compared and replaced with smaller values as they are sampled. Data points that do not exceed maximum or minimum values are discarded.

Min/max data points are computed over a relatively short time period. Old maximum and minimum values are reset to the current value of the waveform at the beginning of the time period.

Therefore, the min/max pair defines changes in the waveform over only a brief time period. Frequently, the maximum value will equal the minimum value. This indicates that the waveform did not change significantly during the period of interest.

## 4-5 Time Annotation

The system log is automatically annotated by the recorder with the current time and date. The system log begins with the symbol "<." This indicates the point on the chart referred to by the subsequent information. The recorders real-time clock supplies the time and date information.

In either case, the recorded time is accurate to within the second. It is important to note that, generally, the "<" symbol of the system log is not synchronized to any particular time. Rather, the symbol is spaced so that time and date information appear at least once every two Z-fold sheets.

### 4-5.1 Real-Time Clock

A low power real-time clock maintains the time and date. The controller board monitors the real-time clock to print the system log time. The 1 second or 1 minute time marks are also generated by the real-time clock. A 3V lithium cell battery backs-up the time and date of the real-time clock. A comparator circuit monitors the 5-volt supply. Whenever the 5-volt power is removed, the comparator switches the real-time clock to battery power. Battery life is 5 years.

## 4-6 Power System

The power system of the DASH II is composed of a group of DC to DC converters. The converters use one of three unregulated input voltages to create several regulated output voltages. Input voltages are obtained from the internal battery, the recorder's built-in AC rectifier, or the external DC source. Whatever its source, the input voltage must not be less than 11 volts or greater than 18 volts.

The internal battery is charged by one of the DC to DC converters. The internal battery is a gelled electrolyte, lead-dioxide type with a nominal output of 12 volts. The charging voltage is 13.8 volts. The charging voltage is only present when either AC or external power is available. If a power source other than the battery is available, the battery is disconnected from the power supply by a relay in the power supply. The relay is operated by the battery-charge voltage.

In addition to the battery charging voltage, the DASH II power supply creates the following voltages:

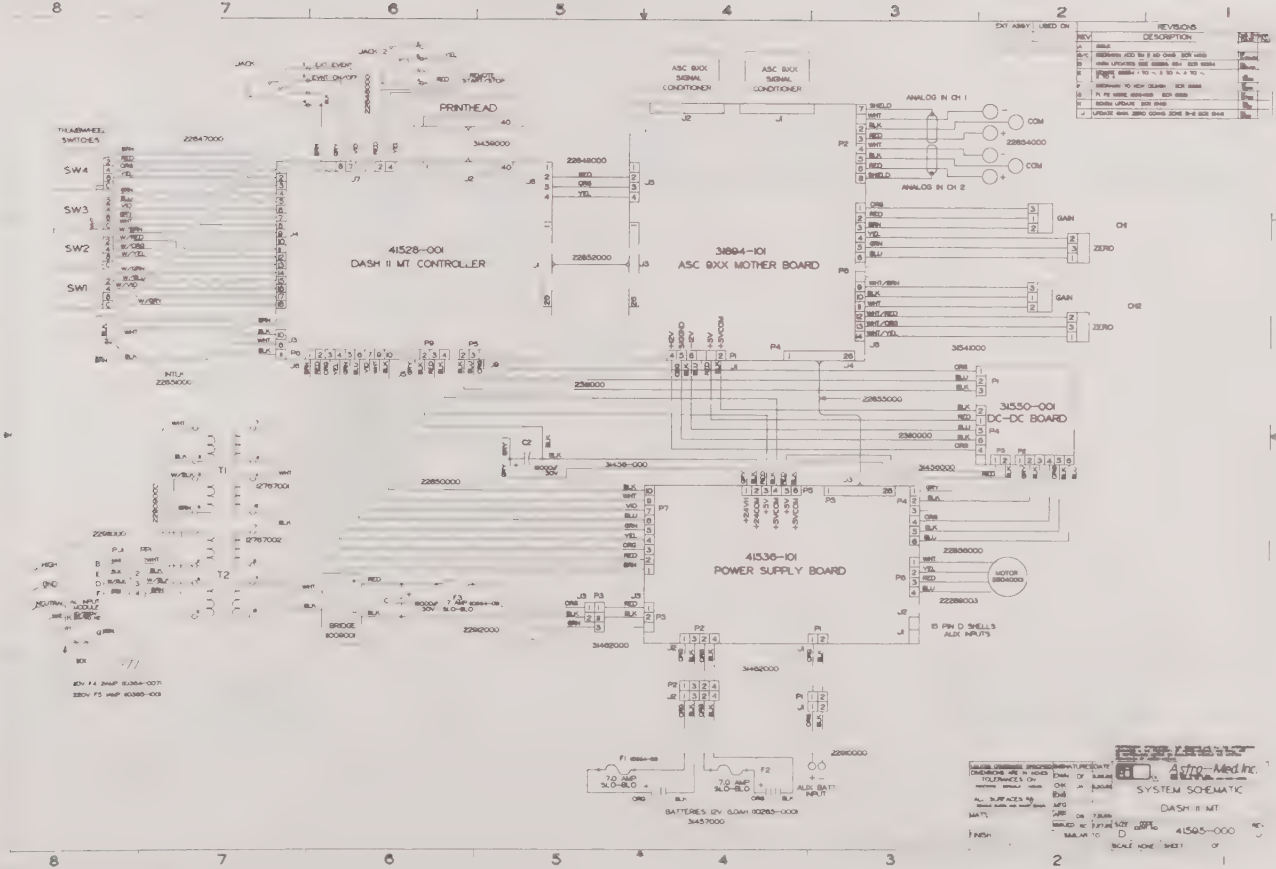
| | |
|---|---|
| 5 volt | logic |
| 26 volt | motor |
| 20 volt | printhead (variable) |

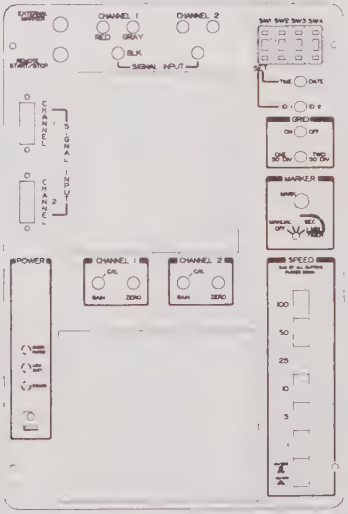
Operation of the printhead power supply has been previously discussed. The motor supply voltage is used to power the motor and as an input to a DC / DC converter. The converter supplies both +12 volts and -12 volts. The converter is an encapsulated module residing on its own printed circuit board.

All the supplies of the power supply board are based on the same integrated circuit switching regulator. They operate at a frequency of approximately 100 kHz. These power supplies employ a number of special features including soft start (to minimize inrush current), short circuit protection, and low input voltage protection.

# Appendix A

## DASH II model MT System Schematic


PRINTHEAD
41528-001
DASH II MT CONTROLLER
34894-101
ASC 9XX MOTHER BOARD
41536-101
POWER SUPPLY BOARD
34550-001
DC-DC BOARD
ASC 9XX SIGNAL CONDITIONER
ASC 9XX SIGNAL CONDITIONER
ANALOG IN CH 1
ANALOG IN CH 2
SW4
SW3
SW2
SW1
GAIN
ZERO
BATTERIES 12V 8.0AH 80283-003
SYSTEM SCHEMATIC
DASH II MT




| NAME | A/M PART NO. | COMP. | P.C. BOARD MOUNTED | FURNISHED MATING PARTS |
|---|---|---|---|---|
| TIME, DATE | 20829043 | S7 | | |
| ID1, ID2 | 20829043 | S6 | | |
| ON, OFF | 20828033 | S3 | | |
| ONE, TWO | 20828033 | S4 | | |
| MARK (CAP) | 2274082 | S5 | 41526-001 | |
| TIMER (7 SW PKG) | 21729007 | S2 | | |
| SPEED (7 SWITCH) | 2175001 | S8 | | |
| EXT MARK (JACK 1) | 10586030 (3C) | J7 | | 10586002 |
| REM ST/STP (JACK 2) | 10586030 (3C) | J7 | | 10586002 |
| SW1 – SW4 | 0287001 | J4 | | |
| | 0287101 | | | |
| | 0287102 | | | |
| CH1 GAIN | 21308502 | R13 | | 21308502 |
| CH1 ZERO | 21308502 | R18 | | 21308502 |
| CH2 GAIN | 21308502 | R1 | 34884-101 | 21308502 |
| CH2 ZERO | 21308502 | R7 | | 21308502 |
| SIG IN CH 1 & 2 (JACK) | 0772001 (RED) | P2 | | |
| | 0772002 (BLK) | | | |
| | 0772003 (GRY) | | | |
| SIGNAL IN CH1 | 10807215 | J2 | | 10808145/0909715 10809880 |
| SIGNAL IN CH2 | 10807215 | J1 | | |
| POWER | 1679802 | P1 | | |
| CHK PAPER (LIGHT) | 10288021 (YEL) | CR9 | 41536-101 | |
| LOW BATT (LIGHT) | 10288021 (RED) | CR10 | | |
| POWER (LIGHT) | 10288023 (GRN) | CR14 | | |

2 MATING PART FOR IEC IS 1078700I
MATING PART FOR 12V INPUT IS 1278300J

1 PC BOARDS MUST BE REMOVED TO GAIN ACCESS TO PARTS, CONSULT MANUAL FOR INSTRUCTIONS.

NOTES:

NEXT ASSY USED ON

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| BLK | ADDED SHEET 2 ECR 14809 | | |
| D | REV SH | | |
| E | REV SHEET | | |
| F | 39884 WAS 41537 WAS WAS -001 ECR 15810 | | |
| G | REV SH - ECR 15324 | | |
| H | REV SH / WARN UPDATE ECR 15410 | | |
| J | REV SH ECR 15444 | | |

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONAL ANGULAR ALL SURFACES RA MATL FINISH

SIGNATURE DATE
DRAWN
CHK
ENG
MFG
APP
QA
RELEASED FOR PUBLICATION
SIMILAR TO

Astro-Med, Inc.
SYSTEM SCHEMATIC
DASH II MT PARTS
SIZE D DWG NO 41595-000 REV J
SCALE SHEET 2 OF 2

8 7 6 5 4 3 2 1

**A-2** DASH II model MT Schematic

# Appendix B

## DASH II model MT Components

| Component | Part Number |
|---|---|
| Batteries | |
| 3 V Coin | 12352-013 |
| 12 V 6.0 A HR Gel Cell | 10285-000 |
| Belt (timing) .08P 7.2LG 3/16W | 20391-100 |
| Bracket Support (Recorder to Case) | 12746-000 |
| D-Shell (15-Pin) | |
| Receptacle plugs w/solder cups | 10909-115 |
| Cable clamp assemblies | 10909-715 |
| Red dust covers | 10909-980 |

| Component | Part Number |
|---|---|
| Drive Roller | 21780-001 |
| Fasteners (Recorder to Case) | 12094-010 |
| Fuses | |
| (F1, F2, F3) Slo Blo 7 A 250 V | 10364-011 |
| (F4) 2 A (1μ) 110 V | 10364-007 |
| (F5) 1 A (12μ) 220 V | 10365-100 |
| Interlock Sensor and Lens | 22851-000 |

| Component | Part Number |
|---|---|
| Knobs & Caps | |
| Knob w/index line (GAIN & ZERO) | 11406-005 |
| Cap | 11406-002 |
| Knob collet 10mm w/line (TIMER) | 22490-002 |
| Cap peaked w/pointer | 22490-010 |
| Manual, Operations | 22834-420 |
| Motor, stepper (with connections) | 22289-003 |

| Component | Part Number |
|---|---|
| Overlay (Front Panel) | 41602-000 |
| Paper (Z-fold) 150-ft pack 300/500 sheets | 40944-543 |
| Plugs | |
| Cannon (3-contact) (external 11-18 VDC input) | 12785-003 |
| Phone 1/4" three-conductor w/black plastic molded handle (external marker jack) (remote start/stop jack) | 10586-002 |
| Power Cord 16AWG 1650 Watts | 10787-001 |

| Component | Part Number |
|---|---|
| Printed Circuit Boards | |
| Controller Board | 41528-001 |
| Mother Board (2-channel) | 31894-101 |
| Potentiometer Board | 41537-001 |
| Power Supply Board | 41536-101 |
| Printhead 4.0 inch | 30995-003 |
| Printhead Springs | 10475-019 |
| Pouch, Document | 31523-000 |

| Component | Part Number |
|---|---|
| Pulleys | |
| 10T 1/8 Bore | 20392-010 |
| 36T 3/16 Bore .080P | 20393-36 |
| Signal Conditioners | |
| ASC-902 General Purpose | 41511-002 |
| ASC-903 High Voltage | 41511-003 |
| ASC-906 DC Bridge Amp | 41511-006 |
| ASC-908 High Gain | 41511-008 |
| ASC-909 Medium-High Gain | 41511-009 |
| ASC-910J Thermocouple | 41511-010J |

| Component | Part Number |
|---|---|
| Signal Conditioners (continued) | |
| ASC-910K Thermocouple | 41511-010K |
| ASC-912 Frequency to Voltage | 41511-012 |
| ASC-913 Logarithmic to DC | 41511-013 |
| Thumbwheel Switches | 12267-101 |

Appendix C

# ASC-900 Series
# Signal Conditioner Specifications

| | |
|---|---|
| **Measurement Range:** | 1 mV/division to 500 V full-scale |
| **Maximum Input (CMV):** | 500 VDC or peak-to-peak AC |
| **Attenuator:** | 14 steps, and OFF: 1, 2, 5, 10, 20, 50, 100 mV/division; 0.1, 0.2, 0.5, 1, 2, 5,10 V/division |
| **Input Coupling:** | AC or DC, selectable |
| **Measurement Mode:** | peak-to-peak or RMS, selectable |
| **Common Mode Rejection:** | 80 dB @ 60 Hz |
| **Input Impedance:** | 2 megohm differential, balanced to common, active guard |

| | |
|---|---|
| **Non-Linearity:** | ± 0.1% full-scale |
| **Low-pass Filtering:** | -3 dB @ 10 Hz, via front panel switch |
| **Filter Roll-off:** | 20 dB per octave |
| **Zero Suppression:** | 0 to ±5 V in the mV range, and<br>0 to ±500 V in the Volt range, calibrated |
| **Calibration:** | internal |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

## ASC-903 High Voltage Signal Conditioner™

| | |
|---|---|
| **Measurement Range:** | 0.5 mV/division to 2000 V full-scale |
| **Maximum Input (CMV):** | 2000 VDC or peak-to-peak AC |
| **Attenuator:** | 16 steps and OFF: 0.5, 1, 2, 5, 10, 20, 50, 100, 200 mV/division and 0.4, 1, 2,4, 10, 20, 40 V/division |
| **Input Coupling:** | DC |
| **Measurement Mode:** | peak-to-peak |
| **Common Mode Rejection:** | 110 dB @ DC |
| **Input Impedance:** | 200 MΩ differential, isolated (1 MΩ in the mV range) |

| | |
|---|---|
| **Non-Linearity:** | ±0.1% full-scale |
| **Low-pass Filtering:** | -3 dB @ 5 Hz or 40 Hz, via front panel switch |
| **Filter Roll-off:** | 20 dB per octave |
| **Zero Suppression:** | maximum 1000% of full-scale (2000 V max.), calibrated |
| **Isolation:** | includes optically-coupled isolation module |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

## ASC-906 DC Bridge Amp Signal Conditioner™

| | |
|---|---|
| **Measurement Range:** | 20 µV/division to 5 V full-scale |
| **Maximum Input (CMV):** | 10 VDC or peak-to-peak AC |
| **Attenuator:** | 12 steps: 20, 50, 100, 200, 500, 1000 µV/division; 2, 5, 10, 20, 50, 100 mV/division |
| **Input Coupling:** | DC |
| **Measurement Mode:** | peak-to-peak |
| **Common Mode Rejection:** | 90 dB @ 60 Hz |
| **Input Impedance:** | 6 megohm differential, active guard |
| **Non-Linearity:** | ±0.1% full-scale |

| | |
|---|---|
| **Low-pass Filtering:** | -3dB @ 5 Hz or 40 Hz, via front panel switch |
| **Filter Roll-off:** | 20 dB per octave |
| **Excitation:** | 0 to 10 VDC adjustable |
| **Zero Suppression:** | 0 to ± 0.5 V in the μV range and<br>0 to ±50 V in the mV range, calibrated |
| **Calibration:** | bridge completion socket and<br>external balance control |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

| | |
|---|---|
| **Measurement Range:** | 1 µV/division to 5 V full-scale |
| **Maximum Input (CMV):** | 10 VDC or peak-to-peak AC |
| **Attenuator:** | 16 steps and OFF: 1, 2, 4, 10, 20, 40,100, 200 µV/division; 0.5, 1, 2, 5, 10, 20, 50, 100 mV/division |
| **Input Coupling:** | DC |
| **Measurement Mode:** | peak-to-peak |
| **Common Mode Rejection:** | 110 dB @ 60 Hz |
| **Input Impedance:** | 6 megohm differential, active guard |

| | |
|---|---|
| **Non-Linearity:** | ± 0.1% full-scale |
| **Low-pass Filtering:** | -3 dB @ 5 Hz or 40 Hz, via front panel switch |
| **Filter Roll-off:** | 20 dB per octave |
| **Zero Suppression:** | 0 to ±5 V, calibrated |
| **Calibration:** | internal |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

NOTE: 1, 2 and 4 μV attenuator ranges require a filter.

| | |
|---|---|
| **Measurement Range:** | 0.1 mV/division to 50 V full-scale |
| **Maximum Input (CMV):** | 100 VDC or peak-to-peak AC |
| **Attenuator:** | 14 steps and OFF: 0.1, 0.2, 0.5, 1, 2, 5, 10 mV/division; 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1 V/division |
| **Input Coupling:** | DC |
| **Measurement Mode:** | peak-to-peak |
| **Common Mode Rejection:** | 80 dB @ 60 Hz |
| **Input Impedance:** | 2 megohm differential, balanced to common, active guard |

| | |
|---|---|
| **Non-Linearity:** | ±0.1% full-scale |
| **Low-pass Filtering:** | -3 dB @ 10 Hz, via front panel switch |
| **Filter Roll-off:** | 20dB per octave |
| **Zero Suppression:** | 0 to ±0.5 V in the mV range, and<br>0 to ± 50 V in the Volt range, calibrated |
| **Calibration:** | internal |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

| | |
|---|---|
| **Measurement Range:** | 0 to 600 °C<br>0 to 1112 °F |
| **Maximum Input:** | 750 °C<br>1382 °F |
| **Selector:** | 6 steps and OFF: 1, 2, 4, 10, 20, 40 deg/div (°C and °F) |
| **Resolution:** | 1 deg/division in all ranges |
| **Measurement Mode:** | °C or °F, selectable |
| **Input:** | Front panel probe input |

| | |
|---|---|
| **Non-Linearity:** | ±1 deg |
| **Zero Suppression:** | -200 to +1000 deg (°C or °F) |
| **Calibration:** | internal |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

NOTE: Includes standard thermocouple probe.

| | |
|---|---|
| **Measurement Range:** | 0 to 1000 °C<br>0 to 1832 °F |
| **Maximum Input:** | 1250 °C<br>2282 °F |
| **Selector:** | 6 steps and OFF: 1, 2, 4, 10, 20,<br>40 deg/div (°C and °F) |
| **Resolution:** | 1 deg/division in all ranges |
| **Measurement Mode:** | °C or °F, selectable |
| **Input:** | front panel probe input |

| | |
|---|---|
| **Non-Linearity:** | ±1 deg |
| **Zero Suppression:** | -200 to +1000 deg (°C or °F) |
| **Calibration:** | internal |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

NOTE: Includes standard thermocouple probe

| | |
|---|---|
| **Measurement Range:** | 20 Hz to 5 megHz full-scale |
| **Maximum Input (CMV):** | 8 VDC or peak-to-peak AC |
| **Attenuator:** | 18 steps and OFF: 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 kHz and mHz, full-scale |
| **Input Coupling:** | DC |
| **Input Impedance:** | 100 Kohm single-ended to floating common |

| | |
|---|---|
| **Non-Linearity:** | +/- 0.25% full-scale |
| **Zero Suppression:** | 0 to 2000% of full-scale |
| **Calibration:** | internal |
| **Special Features:** | microprocessor controlled; resolution down to 1 Hz |

NOTES: 1. Minimum input = 1 V
2. Status reporting feature is not available

| | |
|---|---|
| **Measurement Range:** | -70 dB to +20 dB |
| **Maximum Input:** | 10 VDC or peak-to-peak AC |
| **Selector:** | 5 steps and OFF (each range equals 50 dB full-scale), baseline equals: -70, -60, -50, -40, -30 dB |
| **Resolution:** | 1 dB/division in all ranges |
| **Reference:** | 0 dB = 1 V |
| **Input Coupling:** | AC or DC, selectable |

| | |
|---|---|
| **Measurement Mode:** | peak-to-peak or RMS, selectable |
| **Other Modes:** | dBV is standard, dBm by special order |
| **Input Impedance:** | 8 MΩ single-ended, floating to common |
| **Non-Linearity:** | +/- 0.5% dB |
| **Calibration:** | -30dB CAL button (0.0316 V) |
| **Special Feature:** | "Talking" Signal Conditioner feature sends all signal-conditioner switch settings to the Dash II for printing on the chart |

NOTE: input range equals 316 μV to 10 V

# Appendix D

## DASH II model MT Sample Charts

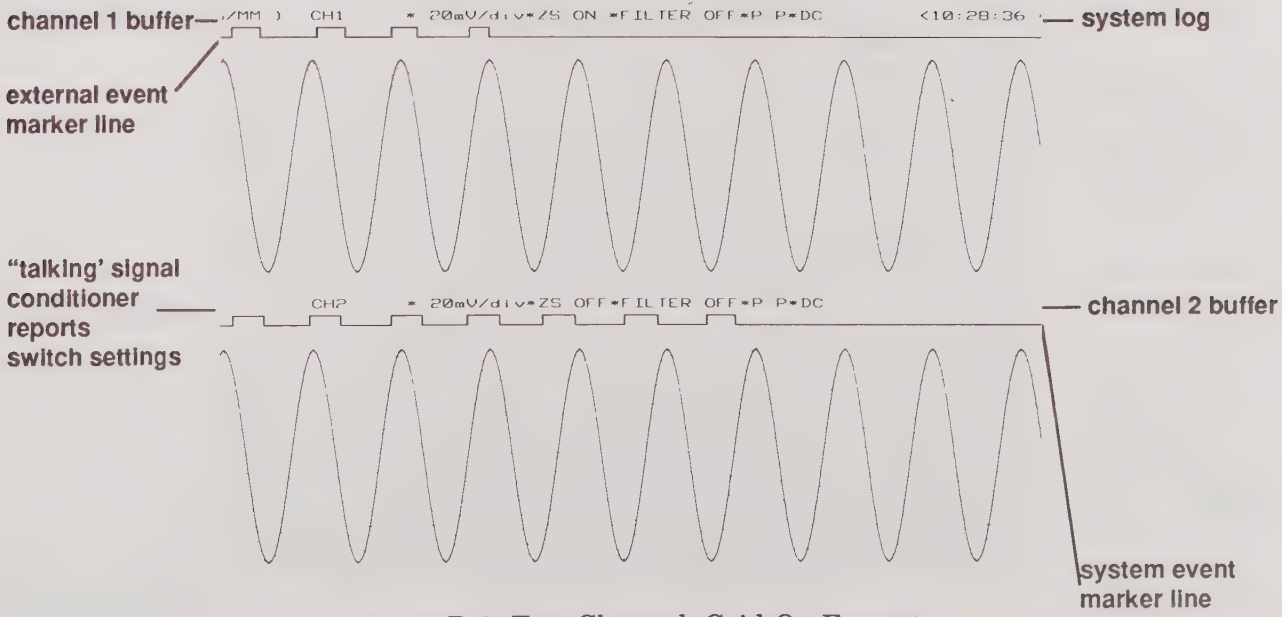

channel 1 buffer
/MM ) CH1 * 20mV/div*ZS ON *FILTER OFF*P P*DC <10:28:36
system log
external event marker line
"talking' signal conditioner reports switch settings
CH2 * 20mV/div*ZS OFF*FILTER OFF*P P*DC
channel 2 buffer
system event marker line

Figure D-1. Two-Channel, Grid-On Format

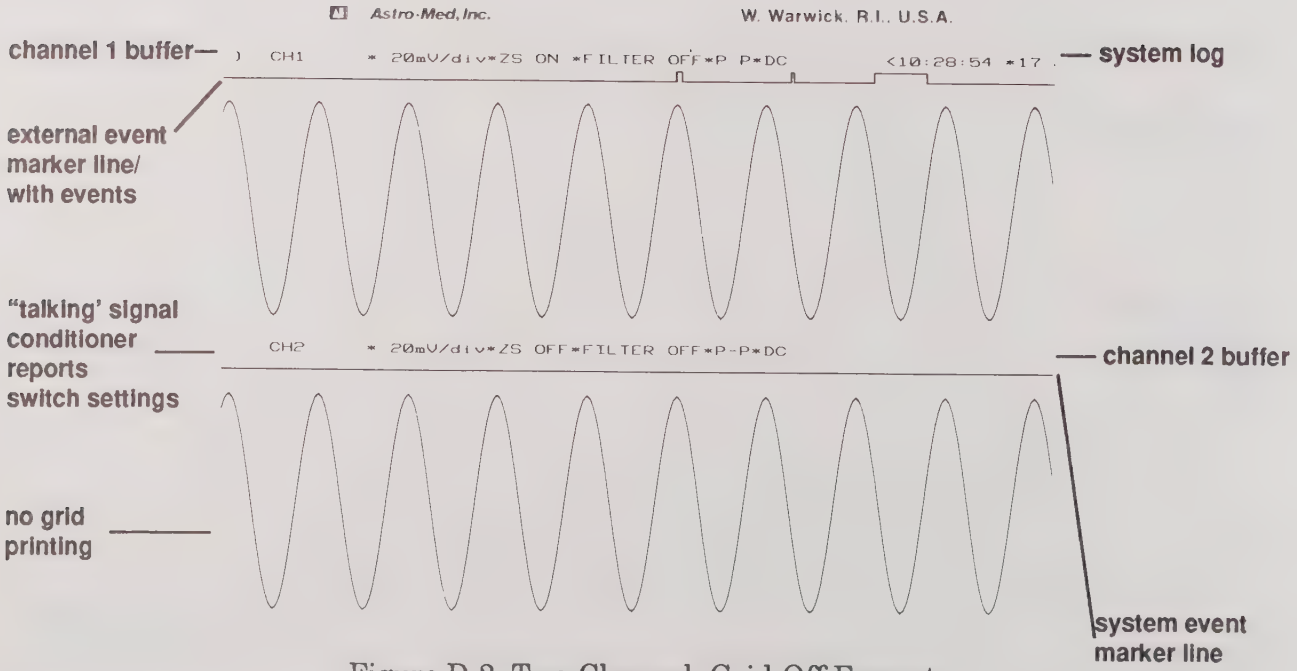



Figure D-2. Two-Channel, Grid-Off Format

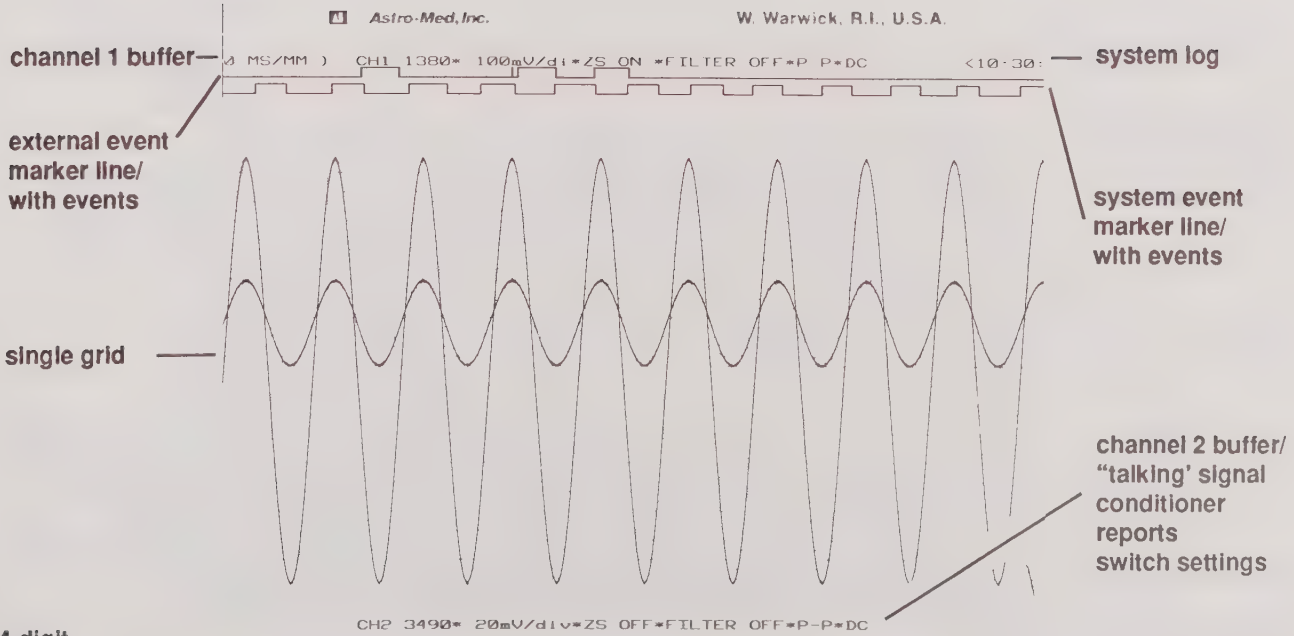

Astro-Med, Inc.
W. Warwick, R.I., U.S.A.
channel 1 buffer
system log
external event marker line/ with events
system event marker line/ with events
single grid
channel 2 buffer/ "talking' signal conditioner reports switch settings
4-digit channel ID

Figure D-3. Overlap, Grid-On Format

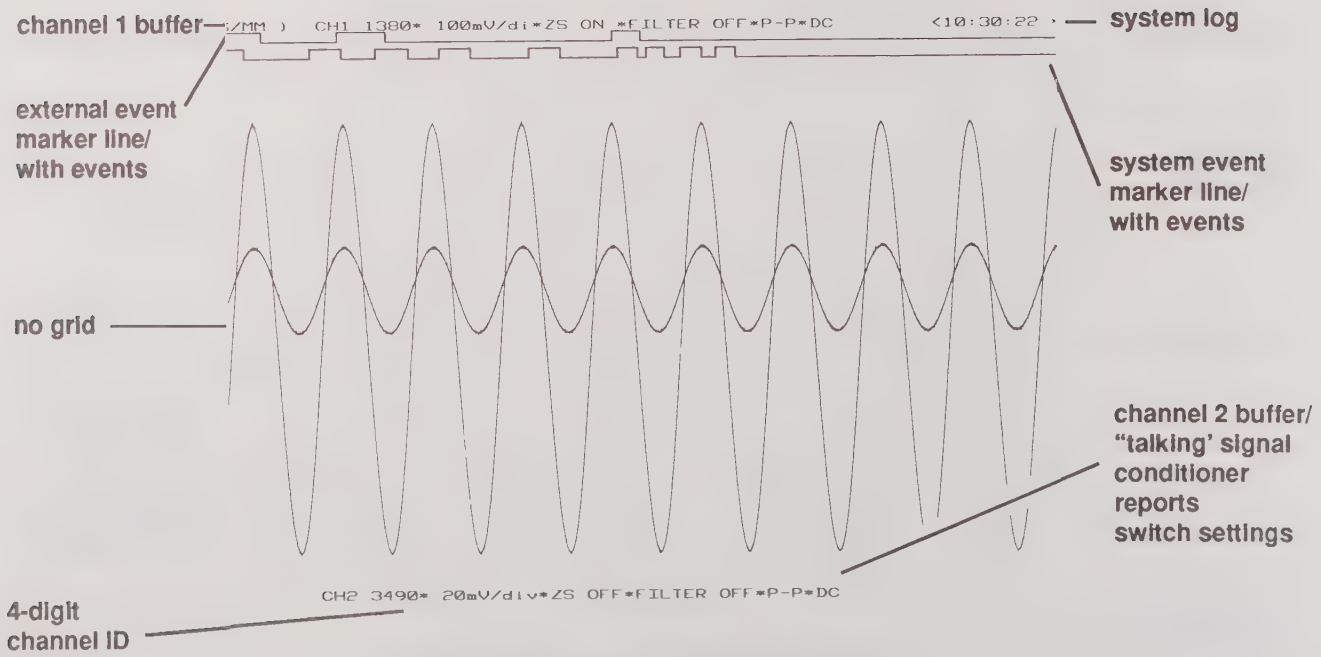



Figure D-4. Overlap, Grid-Off Format

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